The Monthly Review

Published by the AMERICAN ELECTROPLATERS' SOCIETY

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JULY 1939

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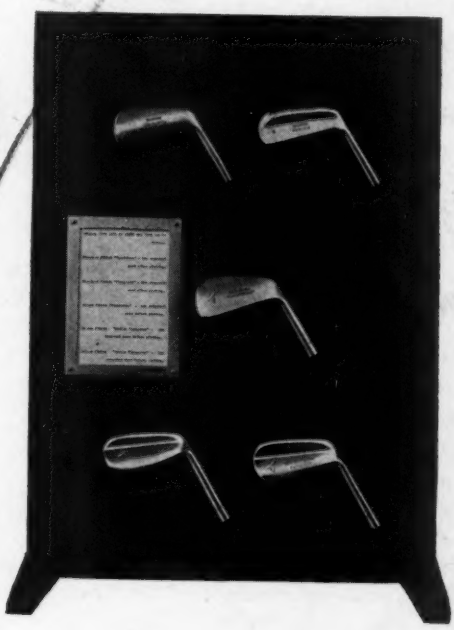

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The Monthly Review

Published by the AMERICAN ELECTROPLATERS' SOCIETY, Inc.

A Society for the Advancement of the Science of Electroplating

JULY 1939

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The Asbury Park Convention

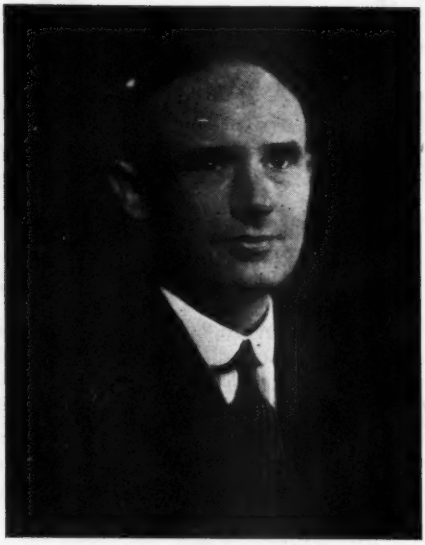
The 27th Annual Convention of the American Electroplaters' Society was held at the Berkeley-Carteret Hotel, June 19-22, 1939. There were over six hundred registrations which made this year's attendance one of the largest ever held. The interest in the educational sessions, the splendid exhibits in which every one of the 29 branches of the Society was represented and the always welcome social events made a combination that has never been excelled in any previous Convention.

After the usual formalities, which included an address by the Society's founder, Mr. Charles H. Proctor of Clearwater, Florida, the Chairman of the Convention Committee, Past Supreme President Horace H. Smith introduced Mr. John B. Kotches, President of Newark Branch, who welcomed the delegates, and introduced President W. M. Phillips as the first business session opened.

Mr. Phillips has recently returned from a business trip to England and the continent. He spoke briefly of some of his experiences "over there".

The first educational session had an international flavor, six papers being read by authors from England and France. Mr. Proctor presided at this session and had the pleasure of introducing as the first speaker, Mr. A. W. Hothersall, Director of Electroplating Research at Woolwich Arsenal, London, and President of the British Electroplaters' Technical Society. Mr. Hothersall was given a great round of applause as he reached the platform. From the moment he made his introductory remarks, he was acknowledged as being a gentleman of culture and refinement and easily won his way into the hearts of his fellow workers on this side of the Atlantic. Mr. Hothersall was keenly interested in every phase of the Society's activities and never missed a session during the four days of the Convention.

Monday Evening as usual was given over to the International Fellowship Club. This organization has sponsored the Buffet lunch, entertainment, music, and dancing for several years now, and each year sees its efforts more and more successful. This year was no exception. Those who have attended such a gather-



ARTHUR WESLEY HOTHERSALL
President of the Electrodepositors Technical Society of England

ing can testify to its value as a means of getting better acquainted with one another, to say nothing of the amusement and enjoyment it affords as old friends meet and new acquaintances are being formed, over six hundred attended this event which lasted until early Tuesday morning.

Mr. George Hogaboom, Chairman of the Educational Committee, deviated from many of the usual customs, all of which won universal favor. One of these was the innovation of asking many of the Presidents of local branches to preside at the various sessions. Among these were Messrs. Acheson of Toronto, Conley of Dayton, Underwood of Philadelphia, J. W. Hanlon of Chicago, and Ralph Liguori of New York. All of these men appreciated the honor and discharged their duties with promptness and distinction. This custom should be continued in future years, so that every branch may be represented by its President at coming Conventions.

Another departure from the usual routine was the presentation of papers by several English authors by means of records which were played on loud speakers. Papers prepared by Messrs. Gordon Francis — Carter and Clarke were presented in this manner, the authors voice in most cases being clear and distinct.

Wednesday morning and afternoon was given over to Plant

visitation. Trips were made to the Anaconda Copper Works at Perth Amboy and to the Hanson-Van Winkle Company's plant at Matawan. Through the courtesy of the latter Company, a most enjoyable luncheon was served at Buttonwood Manor, after which the busses left for Asbury Park for the Evening Educational Session.

At the Final session on Thursday afternoon, Mr. W. M. Phillips presiding, the following officers were elected:

President, R. M. Goodsell, Milwaukee; 1st Vice President, Frederick Fulforth, Philadelphia; 2nd Vice President, Joseph Downes, Middletown, Conn., 3rd Vice President, Nelson Sievering, Montclair, N. J.

Elected Honorary Members of the Supreme Society:

John H. Feeley, Montreal Branch; Charles S. Taylor, Boston Branch; Phillip Uhl, Philadelphia Branch; Hedley Richards, St. Louis Branch; Thomas Brosnan, New Haven Branch

Mr. C. H. Proctor installed the newly elected officers at the close of the final business session.

There was an interesting discussion regarding the desirability of electing so many members to the Supreme Society at one time. It was finally decided that hereafter not more than two members can be elected in any one year. The newly elected Honorary Members were called to the platform, where each one was warmly welcomed by President Phillips with a hearty hand shake, the audience applauding.

PAPER PRIZE AWARDS

The Samuel Heunerfauth Cup for the best branch paper presented—Springfield Branch obtained the honor for their paper, "Answers to some questions on Cyanide Copper Plating", read by D. S. Hartshorn, Jr.

The A.E.S. Medal was presented to W. A. Wesley, International Nickel Company, for his papers "Physical Properties and uses of heavy Nickel Deposits".

The Founder's Gold Medal was presented to Walter C. Pinner and L. E. Borchert for their joint paper on "The importance of proper anode Corrosion in the Electrodeposition of Nickel".

The Proctor Memorial Award of $100., was given to R. O. Hull, E. I. DuPont de Nemours, Cleveland, Ohio for his paper entitled "Current Density Range Characteristics, their Determination and Application".

Metal Industry Cup for best exhibit was awarded to New Haven Branch.

Individual Exhibit Awards

1. Thomas F. Slattery, Baltimore-Washington Branch.
2. S. J. Bart, Newark Branch
3. L. A. Critchfield, Philadelphia Branch.

Honorable Mention, Dr. C. B. F. Young, New York Branch.

THE PAPER AWARDS COMMITTEE OFFERS A GOOD SUGGESTION

The above committee feels very strongly that it could perform its work better and in a more satisfactory manner if it had been organized and started work immediately after the 1938 convention. The committee therefore recommends that the Award Committee for 1940 be appointed in the course of the next 30 days and that it be instructed to start immediately with the evaluation and reading of the papers as they become available in the publications of the Society. (Signed)

C. C. Conley N. E. Promisel W. J. Erskine
E. J. Zurbach E. M. Baker, Chairman

Prof. Baker's suggestion has been turned over to President Goodsell, who will, no doubt, act in accordance with the request of the committee.

As we turn our backs with many fond recollections on Asbury Park, we look forward with pleasure to Dayton in 1940. There is a fine group of members in Dayton Branch. Let us give them our heartiest cooperation as they shoulder the Convention responsibilities. The President is Charles C. Conley, 2505 Catolpa Drive, Dayton and the Secretary, Corliss Powell, 317 Brooklyn Ave., Dayton.

EXECUTIVE BOARD MEETING

Immediately after the Banquet the newly elected officers comprising the Executive Board were called together by President Goodsell. The following appointments were made:

Educational Chairman, Frederick Fulforth, 1st Vice President
Chairman of Exhibits, Joseph Downes, 2nd Vice President
Membership Chairman, Nelson Sievering, 3rd Vice President
Executive Secretary, W. J. R. Kennedy

Routine Business was transacted after which the meeting adjourned.

PROPOSED MILWAUKEE AMENDMENT LOST

The Resolution by Milwaukee Branch that branches of the A.E.S., be restrained from using or soliciting paid ads in support of local functions such as banquets and smokers was beaten by a voice vote.

DAYTON GETS THE 1940 CONVENTION

After some oratory was unloosed regarding the place of next year's meeting, Dayton won over Montreal as the 1940 Convention City. Mr. Charles Conley thanked the Convention in behalf of his city, while Mr. John Feeley pledged his hearty support, which further proves that John is a good sport "and can take it".

To Horace Smith, Chairman of the Convention Committees, we extend our hearty thanks for the success of one of the best conventions ever held. Mrs. Smith and her group of ladies are

also to be highly praised for their work previous to, and during the convention.

There were more ladies at Asbury Park than at any previous Convention. That they had a good time everyone will admit. Some of them saw the Atlantic for the first time. The Convention Committee outdid themselves by inviting a school of whales to hold maneuvers a few hundred yards off shore. This was another inovation that was not on the program. The white hand bags presented to the visiting members of the fair sex were surely appreciated and will be envied by those not fortunate enough to attend the Convention. The gifts were presented to the Ladies after breakfast at the Monterey on Tuesday Morning.

Cleveland Branch had a wonderful representation, over thirty members and their wives coming to the Convention. We missed Past President E. Steen Thompson and Miss Benton. We hope to see you all again next year at Dayton. It's nearer home you know.

We wish to express to the English, French and Canadian authors our appreciation for the Papers they presented at the Convention. Many thanks also to the members and friends of Montreal and Toronto for the interest they displayed in sending the exhibits and for the large attendance from both Branches.

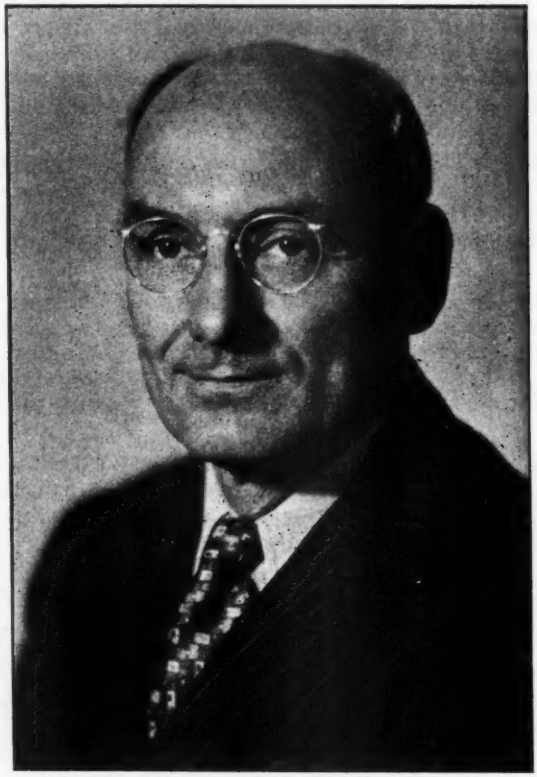
Paul Oldam and the Newark boys worked like slaves the two days previous to the Convention, unpacking the exhibits and putting them inplace. Well, it was worth while. At no Convention has there been such a fine exhibition of plated ware. The popularity of the display was proven by the constant throng of visitors in the exhibit room. Keeping everlastingly at it helped Paul reach his objective. Every branch was represented.

Congratulations Jack Geissman of Milwaukee. Jack is the new Chairman of the International Fellowship Club, succeeding Oliver Sizelove.

Resolutions of sympathy were sent to Mr. Harry MacFayden of Hartford, and Paul Strausser, until recently our associate at the Bureau. Both of these men were ill and unable to attend the Convencion. In a letter recently received from Mr. Strausser, he writes "I wish to express my appreciation for the words of encouragement which the A.E.S. members conveyed to me by telegram while lying in the hospital. I am on the mend and expect to return to Detroit by July 10". Every member of the A.E.S. wishes Paul a speedy recovery and the hope that he may soon be able to take up his new duties with the F. B. Stevens Co.

President Goodsell Speaks

The twenty-seventh annual convention of the American Electroplaters' Society has passed into history, and with its passing we wish to express our sincere thanks to Horace Smith, his co-workers, and the Newark Branch for a splendid convention; to the International Fellowship Club, who so graciously showed their interest at the Convention, and acted as the genial host to the registrants. To the technical men and the practical platers we



PRESIDENT R. M. GOODSELL

extend our deep appreciation for their contribution; and to all those who have contributed their time, effort and money in making this convention a success. The spirit of harmony and friendly cooperation was very much in evidence throughout the convention, and we sincerely trust that this same spirit will continue through the coming year.

As we start upon a new year, we wish to thank the delegates for their loyal support during the past year, and for their express-

ion of confidence in their Supreme Officers by promoting them to carry on the work for the ensuing year.

Within the next thirty days each Branch will be presented with a tentative program, for its approval, which will include the selection of committee chairman to pursue the work of education, membership, exhibits and research, and we sincerely solicit your full cooperation and support.

Mr. W. J. R. Kennedy was unanimously elected by the board to continue the work of the Financial Secretary. The work that he has done in this capacity, and as editor of the MONTHLY REVIEW has been worthy of the highest praise.

There has been a noteworthy improvement in the REVIEW, and we trust that you will keep our editor supplied with helpful material so that its pages may be filled with profitable reading. The advertising has not been all that it could be, but with the cooperation of the branches, we feel that the coming year will see a marked improvement in this important department.

We wish to thank those firms who have contributed to this part of our MONTHLY REVIEW, and trust that for those who have not contributed, circumstances will be such that their names may soon be listed with our other supporters.

Let us add in closing that each member can do much to help carry on this work, and your full cooperation is earnestly solicited.

AUSTIN B. WILSON
Appointed Chairman of Research Committee

President R. M. Goodsell has appointed Past Supreme President, A. B. Wilson of Detroit as Chairman of the Research Committee.

Mr. Wilson has accepted and will name his committee shortly. Their names will be published in the August REVIEW.

Dayton the 1940 Convention City

CHARLES C. CONLEY
President of the Dayton Branch

The Dayton Branch considers itself fortunate and greatly honored to play the role of host to the 1940 convention.

Dayton is ideally located from a transportation standpoint, being 56 miles from the manufacturing center of the U. S. and 43 miles from the center of population.

Dayton is served by the Baltimore and Ohio, Erie, New York Central, and Pennsylvania railroads, the TWA, American, and Marquette airlines and nine motor bus lines.

Thirty four hotels with over 2500 rooms provide ample accommodations at a wide range of prices. Six of the finest hotels to be found anywhere are located within an area of three blocks in the heart of the downtown district.

Dayton has 20 parks covering 1000 acres and 10 excellent golf courses within 15 to 30 minutes drive from the heart of the city.

One of the largest flying fields in the world is located here, comprising over 5000 acres. The U. S. Army Air Corps Supply Depot and the Material Division U. S. Army Air Corps are located on this field.

Four hundred and thirty two manufacturing establishments turn out, acid proof equipment, cash registers, autographic registers, electrical refrigerators and household appliances, envelopes and stamped envelopes, fan belts and tires, golf clubs, water softeners, and home pumps, compressors, ice cream cones, porous metal bearings, paper and wooden boxes, paper cutting machinery and knives, cakes, and crackers, machine tools, plastics, machinery, patterns and publications, hard rubber products, electric motors, motive parts, and accessories, castings, and forgings, lifting jacks, boilers, fire fighting equipment, labels and greeting cards, paint and varnish, air conditioning equipment, bicycles and filling station equipment, tools and dies, cement, marking systems and soaps.

Dayton's outstanding department stores and shops, a million dollar art institute and 10 downtown theatres will be of interest to the ladies.

The Dayton committee pledges itself to make the 1940 convention outstanding.

Anodic Coating of Aluminum

By JUNIUS DAVID EDWARDS
Aluminum Research Laboratories,
New Kensington, Pennsylvania

THE anodic treatment of aluminum is both an old and a new art. The functioning of certain types of anodic films in electrolytic condensers and rectifiers has long been the subject of extensive scientific investigation and commercial application. The extensive use of anodic coatings for the decoration and protection of aluminum surfaces is a later development. Today, anodic coating is used annually as a finishing process for many million pounds of fabricated aluminum articles and structural parts.

If aluminum is made the anode in certain electrolytes, of which solutions of boric acid and borax are typical, an oxide film is rapidly formed. After the initial surge of current the resistance of the film rises to a high value and the current falls correspondingly. When fully formed, the film is thin but quite *impermeable* and is an effective bar to the passage of current. This is the type of film used in the electrolytic condenser.

In other types of electrolytes, such as solutions of sulfuric acid, the film remains *pervious* to the electrolyte and current continues to pass more or less indefinitely with continued growth in oxide formation. It is with relatively thick oxide films of this latter type that this article is concerned. These oxide films have a variety of properties, such as resistance to abrasion, to corrosion, ability to adsorb substances, etc., which adapt them to many applications.

In a historical way, anodic coatings formed in chromic acid electrolytes were first used commercially. Bengough and Stuart[1] in England developed the use of a 3 percent solution of chromic acid as the electrolyte for the oxide coating of duralumin, particularly in aircraft structures. Almost simultaneously, Flick[13] developed an adsorptive oxide coating and discovered that adsorptive oxide coatings could be made electrolytically and colored with dyes. Other forward steps were taken by Gower[14] and Bengston[2] in discovering the advantages of oxide coatings made in

sulfuric acid electrolytes of certain concentrations; the color, hardness and adsorption characteristics of these coatings offered substantial improvement over prior coatings. They form the basis of the well known Alumilite process,— used both in this country and abroad; in Germany, the Eloxal process also employs these methods[12]. Some use has also been made of oxalic acid solutions for the anodic coating of aluminum particularly in Japan and Germany. Direct current is usually employed in the electrolytic oxidation of aluminum but there is a limited use of alternating current for special purposes, as well as the use of alternating current superimposed on direct current.

The film formed on aluminum in the anodic coating process is essentially aluminum oxide. This is true with any of the commercially used electrolytes. The film may contain substances adsorbed from the electrolyte, such as sulfate, and its properties may be modified thereby, but basically, the composition is Al_2O_3. The use of the X-ray seldom discloses any pattern characteristic of the crystalline state, although there are reports of some investigators that the oxide is present in the gamma form (γ-Al_2O_3).

Keller, working in Aluminum Research Laboratories, has found that anodic coatings made with different electrolytes have different optical properties, as can be shown by examination with polarized light[16]. The refractive index of oxide films made by electrolytic oxidation of sheet aluminum of 99.95 percent purity, in dilute sulfuric acid electrolyte has been determined by immersion of the isolated film in liquids of known refractivity. Observed in white light, the refractive index of the unsealed oxide was 1.59. After sealing by treatment in hot water the refractive index was increased to 1.62. The refractive index changes appreciably with differences in the method of production and sealing.

NATURAL COLOR OF THE FILM

Aluminum oxide itself is relatively colorless, but the oxide coating on aluminum may be tinted, either because of the presence of minor impurities comprising iron, silicon, etc., derived from constituents in the metal, or because of adsorbed or occluded substances coming from the electrolyte. Coatings on commercial aluminum sheet (2S) made in chromic acid electrolyte, for ex-

ample, have a gray or greenish tint. Coatings made in some of the sulfuric acid electrolytes are the brightest of all and, when produced on clean aluminum of high purity, are transparent and glass-like in appearance. This is only one of the reasons why the use of sulfuric acid electrolyte has become almost universal.

The natural color of the oxide film may be profoundly modified by alloying elements in the metal or even by minor impurities. During the anodic coating process some alloying elements or constituents are dissolved and consequently have little effect upon the color of the film[17, 18]. Other elements or constituents, however, may be retained or occluded within the film and modify its appearance. Silicon present as an impurity in commercial aluminum may lend an appreciably brownish or gray tint to the oxide film unless the silicon is substantially all in solid solution or extremely well dispersed. Where relatively large amounts of silicon are present, as in certain alloys, the oxide coating will have a brown to black color because of the presence of silicon in the oxide film. Chromium constituent frequently lends a yellow or golden tint to the coating. While magnesium forms a white, colorless oxide, some of the aluminum-magnesium alloys containing substantial amounts of undissolved magnesium constituent have a dark appearance when anodically coated[4]. This is ascribed to the presence of precipitated aluminum-magnesium constituent and the color is decidedly lightened by heat-treatment, adapted to put this constituent into solid solution, before oxidation. In general, the heat-treatment of alloys before oxidation results in a lighter colored coating. Alloys containing substantial amounts of the constituent $MgZn_2$ may be given a gold or brassy colored coating by anodic oxidation.

APPEARANCE

Instead of a uniform, structureless appearance, an oxide-coated surface may sometimes exhibit streaks, often approaching some regular pattern in their uniformity. These streaks are generally undesired, but insuring their complete absence is very difficult because they result from structural characteristics of the original ingot which persist in the worked metal. Progress has been made in eliminating them in certain types of products, but the metal

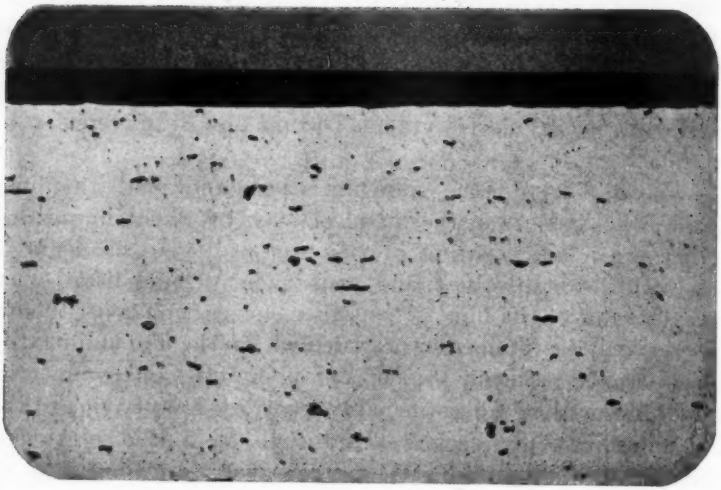


Fig. 1. Photomicrograph showing a cross-section through the anodic coating, on commercial aluminum sheet (2S); magnified 500 diameters.

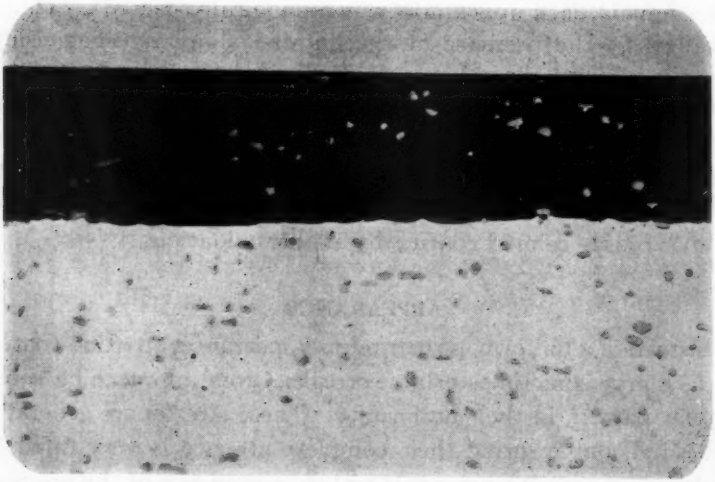


Fig. 2. Photomicrograph showing a cross-section through a thick anodic coating on aluminum-silicon alloy sheet (5 per cent silicon); particles of silicon appear in the coating; magnified 500 diameters.

used for many purposes will show more or less of this effect after oxide coating.

The appearance in cross-section of an oxide coating on commercial aluminum sheet is shown in Figure 1; the thin black line is the oxide coating. In Fig. 2. is shown an oxide coating on an aluminum alloy containing 5 percent of silicon, and particles of silicon are clearly visible in the coating. Figure 3 shows a cross-section of an aluminum alloy containing 10 percent copper, after long-time electrolytic oxidation; the oxidation has penetrated along grain boundaries and through eutectic areas. The apparently detached areas of oxide are connected with the surface through channels lying in other planes than the one photographed.

It is not usually practical to match exactly in appearance, the different oxide-coated parts of a structure when they are made from different alloys and from both wrought and cast members. Much can be done, however, by proper selection of the alloys employed. Welded joints present a problem, since the heat of welding may produce a heat-treatment effect in surrounding areas and cause a change of color in subsequently applied oxide coats.

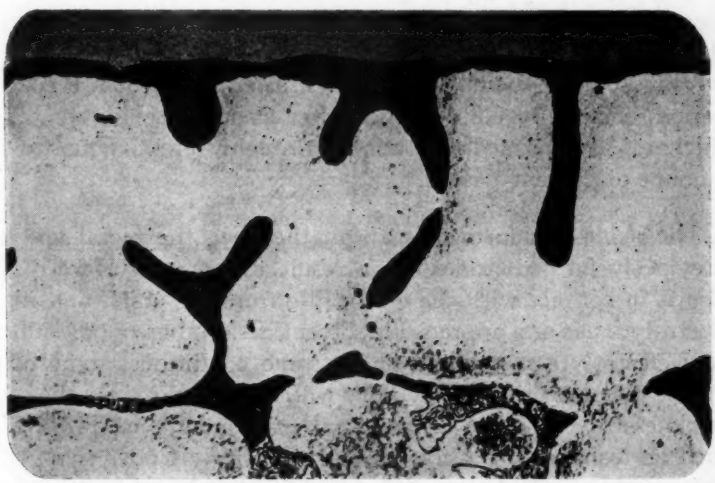


Fig. 3. Photomicrograph showing a cross-section through the anodic coating on a cast aluminum-copper alloy (10 per cent copper); oxide formation follows the grain boundaries and eutectic areas; magnified 500 diameters.

Furthermore, if the welding rod is of different composition, it provides another source of color variation.

The appearance of an oxide-coated surface can be given many useful and artistic variations by suitable treatment before anodically coating. This treatment may be a part of, or constitute the cleaning necessary to prepare the article for the electrolytic oxidation. The oxide coating on wrought products is quite uniform in thickness, as a rule, and hence follows surface irregularities with fidelity. The surface may be buffed for smoothness or etched to give it light-diffusing characteristics. Sand blasting gives good diffusion and is frequently employed as a surface finish on castings which are to be anodically coated. If the surface is not cleaned after blasting, the coating will have a darker hue than usual. Sand blasted backgrounds with adjacent areas high-lighted by buffing give interesting contrasts in color and texture. Satin finishing before anodic coating may be employed to reduce any appearance of streaking.

THICKNESS OF THE FILM

The thickness of the oxide coating which can be formed on aluminum is limited principally by the amount of current employed. With a current density of 12 amperes per square foot, the oxide coating formed in 15 percent sulfuric acid electrolyte at 70°F is about 0.4 mil thick after a half-hour's coating period, and 0.7 to 0.8 mil thick after an hour's oxidation. The thickness at intermediate periods is roughly proportional to the amount of current passed.

The oxide last formed is always between the metal and the previously formed oxide. As a result, the outer surface of the film is in contact with the electrolyte from the start, and if the electrolyte has any appreciable solvent action thereon, as sulfuric acid electrolyte may have under some conditions, some oxide will be dissolved therefrom. This will, of course, reduce the total thickness of the oxide coating and may modify its properties, such as resistance to abrasion and porosity. Under some conditions, there may be a net decrease in the thickness of a piece after oxide coating. For these reasons, the coating thickness is not always proportional to the total current, particularly when

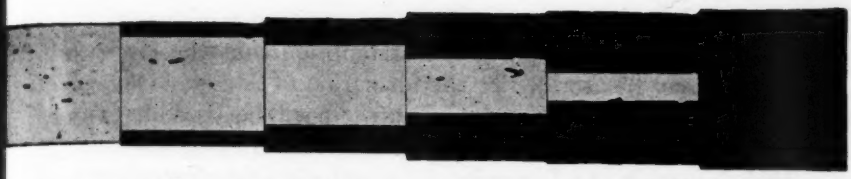


Fig. 4. Photograph showing six stages (in cross-section) in the electrolytic oxidation of aluminum foil; untreated foil at the left, completely oxidized foil at the right and intermediate stages in between; magnified 500 diameters.

extended coating times are employed or the electrolyte is heated substantially. Methods of measuring the thickness of oxide films are described in a report of the American Society for Testing Materials[10].

The course of anodic oxidation of a piece of aluminum foil (0.00114″ thick) is illustrated in Fig. 4 and by the measurements recorded in Table 1. In the figure, a cross-section of the original foil is shown at the left and a cross-section of the completely oxidized foil at the right, with intermediate stages in between. In the photomicrograph, the oxide coating appears black and the unoxidized aluminum is bright. It is obvious that the oxide occupies a greater volume than the aluminum metal from which it was formed. The foil, after 30 minutes' coating, had a total thickness of oxide on both faces of 0.90 mil and the foil had increased in thickness by 0.3 mil, or by an amount about equal to one-third the thickness of the oxide coating.

TABLE 1.

THICKNESS MEASUREMENTS ON ANODICALLY TREATED ALUMINUM FOIL*

According to measurements by C. J. Slunder and F. Keller Aluminum Research Laboratories

Time of anodic oxidation	Total thickness of foil mils	Thickness of oxide coat on one side of foil mils	Increase in thickness of foil by oxide coat on both sides mils
0	1.14	0	
10	1.19	0.14	0.05
20	1.29	.26	.15
30	1.42	.45	.28
45	1.50	.59	.36
60	1.62	.80	.48

It is possible to calculate the current efficiency of the oxidation process at the anode upon the assumption that the increase in weight may be ascribed to the formation of Al_2O_3. This is, of course, not an exact assumption, as there will be a certain amount of adsorbed sulfate, etc., in the coating. On the original assumption, however, the formation in a sulfuric acid electrolyte of a 0.2 mil coating on aluminum of 99.8 percent purity showed an average apparent current efficiency for six specimens of 75 per cent, and for 2 specimens of 99.2 per cent aluminum, the apparent current efficiency was 69 per cent. Finally the oxide coating was removed without attacking the aluminum, and from the original weight of the aluminum and the weight of metallic aluminum left after oxidation, it was found that the aluminum lost corresponded to an apparent current efficiency of 101 per cent. The apparent current efficiency would be increased above 100 per cent if some chemical solution of the aluminum occurred. The figures indicate, however, that the aluminum oxidized or dissolved is about equal to the electrochemical equivalent of the current employed.

ADSORPTION CHARACTERISTICS

An important milepost in the history of oxide coatings was Flick's discovery that adsorptive electrolytic oxide coatings could be colored with lake-forming dyes[13]. This ability to be colored extended the field of application of these coatings. While it is true that all dyes are susceptible to eventual fading in sunlight, their resistance to fading differs widely. As a result of extended investigation and selection, satisfactory dyes are available now for most of the wanted colors. Their use under controlled conditions results in colored oxide coatings which resist fading for long periods indoors; even outdoors they may have a limited use for certain applications. The light-fastness of the dyed oxide coating can be increased by suitable sealing treatments. Certain dyes, notably the basic dyes are not adsorbed by oxide coatings. Tosterud discovered, however, that by first adsorbing a suitable mordant on the oxide, the basic dye could then be adsorbed on the mordanted surface.

The discovery that adsorptive oxide coatings could be colored

with pigments by precipitation within the pores has effected more durable means of coloration[24]. The range of colors is, however, much more limited than is the case with dyes. If, for example, an oxide coating is first treated with a solution of potassium dichromate so as to adsorb chromate strongly within the pores, and the coating is then treated with a solution of lead acetate, insoluble lead chromate is precipitated within the pores of the coating. This both seals the coating and gives it a bright, chrome-yellow color. A jet black is provided by the precipitation of cobalt sulfide, and blue by the precipitation of Prussian blue within the pores of the coating.

Mason discovered that adsorptive oxide coatings could be impregnated with photo-sensitive salts and photographs reproduced thereon by exposure to light through a negative, followed by the usual developing and fixing processes[20].

That the oxide is truly adsorptive may be demonstrated by simple experiment. A certain coating made in sulfuric acid electrolyte was found to have a thickness of 0.57 mil and the volume of oxide coat per square meter of surface was 14 cc. This coating was then impregnated by treatment in a boiling 1 per cent solution of potassium dichromate. Upon analysis, the coating was found to contain 0.48 gram chromium per square meter, corresponding to about 1.4 grams potassium dichromate per square meter. This 1.4 grams of potassium dichromate was originally contained in 140 cc of solution, and since the coating itself had a volume of only 14 cc (the pore space was something less), dichromate must have been adsorbed from the solution and concentrated on the pore surfaces as fresh solution continued to diffuse into the pores.

Impregnation of oxide coatings with chromates has provided an important means of increasing the resistance to corrosion afforded by oxide coatings[5]. Treatment with chromate helps to complete the oxide coating on the metal at the base of the pores, and the adsorbed chromate provides a ready supply of corrosion inhibitor during any later attack of the surface by a corroding medium. Adsorbed silicate is another corrosion inhibitor which may be employed in this way[6].

SEALING

The type of oxide coating under consideration is essentially porous as it comes from the electrolytic bath. This must be so, for the electrolyte penetrates the coating and current continues to pass as long as sufficient voltage is applied. It is this porosity of the oxide which makes it so adsorptive. However, it lowers the resistance to corrosion and permits undesirable staining and coloring. Anodically coated cafeteria trays, for example, are stained by coffee unless they are given a sealing treatment. Ice-cube trays must also be sealed against staining. The term "sealing" has been applied to treatments which make the oxide coating impermeable, non-adsorptive, or non-staining.

The sealing process most generally employed is treatment with hot or boiling water[3]. Highly adsorptive coatings treated in this way become proof against staining. X-ray studies made upon the coating before and after treatment with hot water show that amorphous oxide (Al_2O_3) has been converted into aluminum monohydrate ($Al_2O_3.H_2O$). Presumably this reaction takes place at the surfaces lining the pores. It is also reasonable to assume that the monohydrate is formed with an increase in volume. The resultant swelling action therefore helps to close the pores and decrease the surface available for adsorption. The color and appearance of the oxide coating are not particularly changed by this water-sealing treatment.

The pores in the coating may also be closed by treatment in hot solutions containing nickel or cobalt acetate[23]. Apparently colloidal hydroxides of these metals formed by hydrolysis are occluded or adsorbed in the pores of the coating and help to close them.

Obviously, a variety of materials may be used to seal coatings in order to give them specific properties. Oils, such as linseed oil and tung oil, and waxes, such as lanolin and paraffin, have been used for this purpose. The impregnation may be effected hot or cold. A common practice is to immerse the oxide-coated article in the hot oil or molten wax until any gas in the pores is driven out and replaced with liquid. The wax or other impregnating sub-

stance may also be dissolved in a volatile solvent and applied to the surface by dipping, brushing or spraying. In addition to sealing, some of these materials may also function as surface lubricants.

In cases where it is desirable to render any portion of an oxide-coated surface non-adsorptive, it can be sealed in various ways or coated with stop-off materials. Using stop-offs, it is possible to seal selected areas on an oxide-coated article and then completely immerse the article in a coloring solution so that only the untreated parts become colored thereby. By the use of stop-offs, it is possible to reproduce patterns or letters in a number of colors.

RESISTANCE TO ABRASION

Crystalline alumina, such as the mineral corundum or emery, is an extremely hard substance and it is not surprising, therefore, that compact electrolytic oxide coatings on aluminum should be resistant to abrasion. The fact should be borne in mind, however, that even though the coating is very hard, it is also very thin, and is supported by a metal base which is inherently softer and less resistant to deformation. Because of the softer supporting material, it is not difficult to scratch through oxide coatings with a sharp-edged instrument, such as a knife. However, for the rubbing type of wear, these oxide coatings give excellent service. They do not mark porcelain or enamel surfaces and have the additional advantage that they eliminate smudging such as is sometimes experienced when a white fabric is rubbed against a bare aluminum surface. This is an important characteristic on such an article as a cafeteria tray.

Various methods have been suggested for measuring abrasion resistance and several of these have been found useful in connection with oxide coatings. The abrasive air-blast method appears to give the most reproducible results, while the rotating abrasive wheel appears to show more of the effect of the supporting metal.

Results using the abrasive air-blast method, shown in Table 2, indicate that the resistance to abrasion measured in this way is approximately proportional to the thickness of the oxide coat-

ing[10]. However, when the abrasion resistance is measured with a rotating abrasive wheel, coatings applied to the harder base metal appear to have a greater resistance to this type of abrasion. Of course, resistance to abrasion may vary with the structure of the coating itself, and this is a factor which must be taken into consideration. The coating tends to become softer as its porosity increases. Long-continued oxidation usually results in some reduction of the abrasion resistance of the oxide at and near the surface of the coating. The most abrasion-resistant coatings are produced on 2S and 3S and some of the magnesium-containing alloys, such as 4S, 51S, 52S and 53S.

MECHANICAL PROPERTIES

The oxide coating will crack on bending but the oxide is adherent and does not flake off. The cracks may not be objectionable under some circumstances and their effect upon resistance to corrosion may be minimized by suitable sealing procedures. Very porous oxide coats may appear to be flexible simply because the cracks which form on severe bending do not show readily. Whenever possible, any necessary mechanical working of a piece should be carried out before oxidation.

Oxide coatings 0.0004 inch thick, made in sulfuric acid electrolyte on .064″ 17S-T sheet, had no appreciable effect upon such properties as tensile strength, yield strength and elongation, but flexural fatigue tests on sheet indicate that an oxide coating results in a slight decrease in life at high stresses and an increase in life at lower stresses. The endurance limit of 17S-T sheet is increased about 1500 to 2000 pounds per square inch by an oxide coating.

REFLECTION AND RADIATION CHARACTERISTICS

A pure aluminum surface has a reflectivity of about 90 per cent for visible radiation, and the reflectivity rises in the infra-red region of the spectrum to values as high as 97 per cent. Aluminum is also a good reflector of ultraviolet radiation. These aluminum surfaces, of course, have the natural oxide film which always forms on exposure of the metal to air, and which is on the order of

TABLE 2.

RESISTANCE OF OXIDE COATINGS TO ABRASION

Description of Sample	Thickness of oxide coating mils	Grams of Alundum in air-blast required to wear thru coat	Ratio of abrasion resistance to thickness mils x 10^2	Revolutions of Crystolon wheel required to wear through the coat	Ratio of abrasion resistance to thickness mils x 10^2
Hard rolled aluminum, (2S) Brinell number, 44	.15	30*	2.0	100†	6.7
	.30	72	2.4	145	4.8
	.44	110	2.5	185	4.2
	.60	148	2.5	250	4.2
Heat-treated aluminum alloy, 53ST** Brinell number, 80	.17	35	2.1	78	4.6
	.32	79	2.5	225	7.0
	.46	120	2.6	330	7.2
	.60	161	2.7	450	7.5

*Average of 8 observations.

†Average of 2 observations.

**Nominal composition - magnesium 1.3%, chromium 0.25%, silicon 0.7%, balance aluminum.

1 or 2 x 10^{-6} centimeters in thickness. If the aluminum is covered with a thicker oxide coating produced by chemical or electrochemical means, its reflection characteristics will be modified. Within the range of commercial thicknesses, the reflectivity for light decreases somewhat as the thickness of the oxide coat increases. This loss of reflectivity after anodic coating also increases as the content of the metal in such elements as iron and silicon, for example, increases.

In the infra-red region, the optical characteristics of aluminum may also be modified in an important way by oxide coating[22]. In Figure 5 is shown a graph giving the relationship between the emissivity at 100°F and the thickness of oxide coat upon aluminum. The emissivity or radiating power is expressed as a percentage of the radiating power of a black body at the same temperature, - in this case, 100°F. The peak energy radiated at a temperature of 100°F is at a wave length of 9 to 10, μ (0.009 to 0.010 mm). The reflectivity for radiation from a black body at 100°F (or any other temperature) is obtained by subtracting the emissivity values (at that temperature) from 100 per cent. It will be seen from this curve that the reflectivity is reduced or the emissivity increased in proportion to the thickness of the oxide until a thickness of about 0.1 mil is reached, after which the

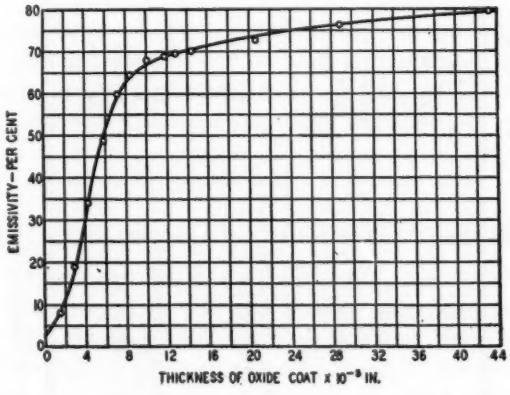


Fig. 5. Relation between thickness and emissivity (at 100°F) of an electrolytically produced oxide coat on aluminum.

change is slower. When, therefore, an aluminum surface is to be used as a reflector for long-wave infra-red radiation, say 6 μ and longer, the thickness of any oxide coat on the surface will be a factor in determining its efficiency. The fact should be borne in mind, however, that where the radiant energy comes from a fairly high temperature source, a substantial amount of the radiation may be in the visible range and in the very short infra-red range, say 1 to 3 μ, where the effect of the oxide coat in reducing reflection is a minimum. Alzak reflectors, described in a following paragraph, have proven efficient in drying with near infra-red radiation. Ickis and Haynes have published data on the spectral reflectance of Alzak reflectors which show no loss in reflectivity at 2 μ, where the reflectance was still over 90 per cent[15].

The oxide coating also reduces the reflection of radiation in the ultraviolet range. For this kind of radiation, an efficient reflector should have only a thin oxide coating[7].

The use of aluminum for reflectors has been greatly extended by Mason's discovery of the electrolytic brightening treatment, one example of which comprises treating the aluminum reflecting surfaces as anode in a dilute solution of hydrofluoboric acid [7, 11, 19]. This results in the removal of impurities from the surface and a marked increase in reflectivity without any appreciable roughening of the surface. After this preliminary treatment the surface can be given an oxide coating of substantial thickness and protective value, but with minimum loss in reflectivity. Specular reflectors can be made by the Alzak* process, which have a reflectivity of about 84 per cent and carry a clear, glassy oxide coating of 0.2 mil or more in thickness. A process of electrolytic brightening in a solution of sodium phosphate and carbonate was later developed by Pullen[21].

THERMAL PROPERTIES

Aluminum oxide is, of course, very stable when subjected to high temperature, and oxide-coated aluminum surfaces will stand considerable heating without depreciation. Heating above certain

*Alzak is a registered trademark of the Aluminum Company of America.

temperatures, however, will cause crazing of the surface[11]. The metallic aluminum base has a higher coefficient of expansivity than the oxide, and when the difference in expansion of the metal and the oxide becomes great enough, fine cracks result. As a rule, these cracks are almost invisible and frequently can be detected only by viewing the surface at an angle close to that of grazing incidence. Surprisingly, they also seem to have little effect in lowering the resistance to corrosion.

The temperature at which crazing will result depends upon the method of production of the coating. Generally speaking, however, temperatures of 300°F to 400°F should not be exceeded unless special processing methods are employed. With thick oxide coatings it may be necessary to keep the temperature as low as 250°F if all crazing is to be avoided. The effects of heating the oxide must be considered wherever a baked enamel is to be applied to a portion of an oxide-coated surface as, for example, when enamel numerals are to be applied on an oxide-coated automobile license plate. Consideration should also be given to the effect of the heating on the metal itself, particularly where the alloy is susceptible to age hardening.

ELECTRICAL CHARACTERISTICS

Aluminum oxide is a good dielectric and some use has been made of oxide coatings as an insulating medium on aluminum. An oxide coating of 0.5 mil thickness, made in sulfuric acid electrolyte and sealed, may exhibit a breakdown value as high as 500 or 600 volts. Unfortunately, however, the minimum breakdown voltage is usually lower, perhaps 200 to 300 volts, because of the presence of weak spots in the coating. The apparent breakdown value of the coating will therefore vary, depending on whether a flat electrode of substantial contact area or an electrode with point contact is employed in measuring the breakdown voltage[10]. An important characteristic of the oxide coating as an insulating medium is that it is stable when heated, and does not char or give off gas as do organic insulating materials when overheated. The cost of application, however, is one factor which limits its general use.

The discussion in the preceding paragraph refers to the dry oxide coating. When aluminum is in the forming electrolyte, the voltage relationships are quite different. Current readily flows with an aluminum anode under a potential of 10 to 15 volts in sulfuric acid electrolyte, but in boric acid electrolyte the potential may rise as high as 500 volts without any appreciable flow.

WEATHER PROTECTION

Some of the important applications of anodic coatings are in the structural and architectural field. The oxide coating, properly processed, offers substantial protection against the weather. Although any attack on bare aluminum surfaces is usually small and self-stopping because of the natural formation of protective oxide films, nevertheless roughening of the surface leaves it in a condition to collect dirt more readily, and dirt, where not removed, may hold moisture tenaciously and result in further attack. Smooth, hard coatings minimize surface corrosion and if dirt and dust are regularly removed by maintenance procedure, the bright, clean appearance of the surface can be maintained almost indefinitely.

The proper sealing of an oxide coating increases its protective power. This is well illustrated by the data of Table 3, which show the effect of exposure to salt spray on the physical properties of 17S-T, which is an alloy of the duralumin type. Just as sealing with hot water improves the resistance to corrosion over that of the unsealed sample, the table shows that sealing with dichromate produces a substantial improvement over the hot water seal. This is most clearly shown by noting the per cent reduction in elongation resulting from the exposure, which was only 4.5 per cent in the case of the chromate-sealed sample, an amount which is negligible.

An electrolytic oxide coating on ice-cube trays and other containers is particularly effective in stopping any staining or darkening which might result from tap water standing in contact with the aluminum for long periods. On architectural parts, such

TABLE 3.

SALT SPRAY EXPOSURE TEST ON ANODICALLY COATED ALUMINUM ALLOY*

Electrolyte employed for Coating	Sealing Method	Period of Exposure to Salt Spray years	Physical Properties†					
			Before Exposure		After Exposure		Change per cent	
			Tensile Strength lbs/sq. in.	Elongation per cent	Tensile Strength lbs/sq. in.	Elongation per cent	Tensile Strength	Elongation
Sulfuric acid	Hot water	1‡	58,385	19.5	57,410	16.3	-1.7	-16.4
" "	$K_2Cr_2O_7$	1	59,035	19.8	58,790	18.9	-0.4	-4.5
Chromic acid	None	1	58,305	19.5	54,445	13.2	-6.6	-32.

*Nominal composition of 14 gage sheet: copper 4%, magnesium 0.5%, manganese 0.5%, balance aluminum. The oxide coatings were representative of commercial coatings produced in these electrolytes and were approximately 0.4 mil thick on samples coated in sulfuric acid electrolyte, and about 0.1 mil thick on sample coated in chromic acid electrolyte.

†Average of tests on 5 samples.

‡Exposed continuously to spray from a solution containing 20 per cent sodium chloride.

as window frames, doors, etc., the oxide coating maintains a hard surface which is readily cleaned and maintained. On parts such as spandrels, mullions, and the like, the oxide-coated aluminum surface retains its artistic appearance over long periods.

In the aircraft field, protective oxide coatings have generally been used in combination with paint. The oxide coating renders the surface passive and resistant to corrosion, and when it is further protected by a moisture-proof painting system, the degree of protection afforded is very substantial[8]. Anodic coating in chromic acid electrolyte, or in sulfuric acid electrolyte followed by a chromate sealing treatment, is good surface preparation for a paint system comprising a zinc chromate primer with aluminum-pigmented top coats in synthetic resin vehicle, and affords good protection for thin duralumin sheet or other aluminum alloy parts[9]. The same type of surface protection may also be used on forgings and castings. In the case of castings, however, it is very desirable to bake the casting at a low temperature after oxide coating, in order to insure complete removal of moisture from any pore spaces before painting.

In general, the chemical resistance of oxide coatings is greatest in approximately neutral solutions. If the hydrogen ion concentration of the solution in contact with the oxide coating decreases to a point of appreciable alkalinity, there is likely to be attack. Strongly alkaline cleaners should not be used on oxide-coated surfaces. There is a greater range of stability on the acid side, and except where the solution has specific solvent action for aluminum oxide (citric acid, for example), its serviceability is usually quite excellent when the pH of the solution is not below 4 or 5.

It is not practical in a relatively short article to sketch more than an outline of the properties of anodic coatings on aluminum. Enough has been said, however, to indicate the versatility of the process and to show some of its commercial possibilities. Research and development work now in progress should extend its usefulness.

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NOTE: The date given for a patent is the issue date which is later, of course, than the filing date and the date of discovery.

NEW HAVEN BRANCH

The annual banquet of the Chemistry Class of the New Haven Branch of the A.E.S., was held Saturday, June 3, at the Hejaz Grotto in New Haven. Some 90 members of the Chemistry Class, guests from other Branches, and guests attended this affair.

Preceding the dinner, the members enjoyed a bowling session, and also some questionable pool shooting. Bob Mooney's sharp-breaking curve ball was an outstanding feature of the bowling. It not only broke right through the pin, but also broke Bob as far as betting was concerned.

The expert pool-shooting of Joe Downes ("that's the way I played it") and Bill Bridgett ("the cue slipped") made it possible for them to win a disputed match from Henry "Dead-eye" Creamer and Tom "Masse-shot" Chamberlain.

The dinner itself was a howling success. A fine "New York" floor-show featured by a very boot-i-ful akordeen player, some fine acrobatic and clog dancing, plus an excellent comedian and piano music, and Charlie Koelbel's inimitable pianoforte renditions all combined to make a most enjoyable evening of entertainment.

Following the dinner, Professor J. Vance of the Yale Dept. of Chemistry, and instructor of the Chemistry Class of the New Haven Branch gave a few complimentary remarks about the interest that was shown by the members in this work.

Next, the newly elected officers were installed and each one in turn was called upon to say a few words. The officers are: President, Henry Creamer; Vice President, Tom Chamberlain; Secretary-Treasurer, Robert Gray; Librarian, Joe Sullivan; Asst. Secretary-Treasurer, Doc Garner.

Supreme Secretary Bill Kennedy commented quite favorably on the work of the New Haven Branch, and suggested that all the members make an effort to get to the National Convention at Asbury Park, June, 19 to 23. The meeting was closed by a few remarks by Tom Chamberlain, past Librarian, and he urged the members to give their full support to the course in metallurgy to be given the coming year.

The committee for the banquet was headed by Charlie Koelbl who did such a fine job that he will have a very difficult time of escaping from handling such affairs in the future.

The final open meeting of the season was held Tuesday, June 6, at the Sterling Chemistry Laboratory with Dr. E. A. Anderson of the New Jersey Zinc Co. as guest speaker. Dr. Anderson gave a most interesting and enlightening talk on "Zinc Base Die-Castings".

JOSEPH T. SULLIVAN, Sec'y-Treas., New Haven Branch

Obituary

Mr. William R. Conlon, Associate Member of Detroit Branch A.E.S., passed away June 6, at Harper Hospital in Detroit. Burial took place at Muskegon, Mich., the city where he spent his boyhood, and school days. He was born at Brantford, Ontario on April 13, 1911, but was brought by his parents to Muskegon, Mich., at the age of nine. After graduation, Bill came to Detroit and became employed by Collard, Inc. In 1937 he became connected with Automotive Rubber, Inc., and served as Plant Superintendent from that time until his death.

Bill's many friends in the plating industry will miss his likeable presence, and the Detroit Branch will miss his loyal support.

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Providence, R. I.

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Plantsville, Conn.

Scovill Mfg. Co.
Waterbury, Conn.

Silver City Glass Co.
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New Haven, Conn.

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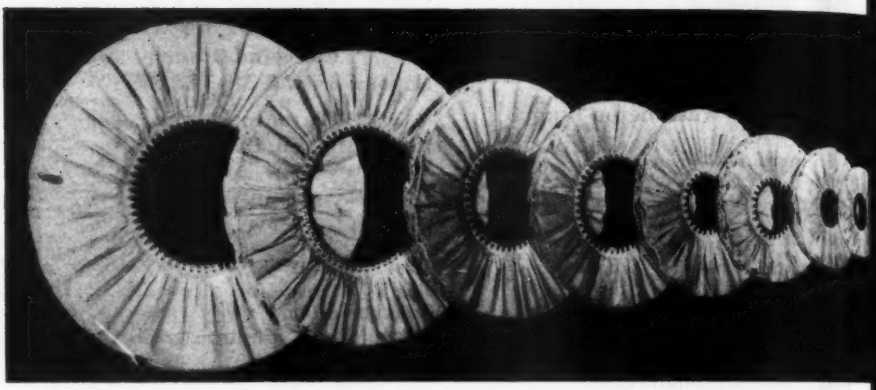
AIRWAY *Ventilated* BUFFS



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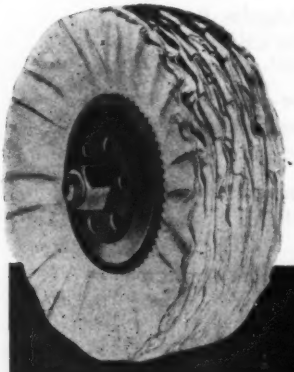
5 FEATURES "AIRWAY" COOLING

1. Permits 50% to 100% higher speeds.
2. Faster cutting and does not ridge the work.
3. Eliminates burning.
4. Raveling eliminated, requires no raking.
5. Saves compound.

Made in all grades of cloth. Only bias material used. Available diameters 5" to 18".

Permanent tapered spindle adapters supplied on all small sizes for use on tapered spindles.



Use half as many sections.
Wears twice as long.
Costs half as much.

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AIRWAY *Ventilated* BUFFS

VENTILATION

The AIRWAY BUFF is used with metal center plates and flanges so arranged as to allow the centrifugal action of the buff to draw air in at the sides of the wheel and pump it out radially between the buff sections. This circulation of air through the AIRWAY keeps it cool under most severe operating conditions, entirely eliminates burning and thus prolongs the life of the buff. This permits 50% to 100% higher speeds.

COMPOUND SAVING

The bias construction of the AIRWAY eliminates ravel and wasting of buff as well as compound.

The ventilating feature keeps the buff cool and reduces the tendency of the compound to melt and be thrown off.

The AIRWAY should not use more than 50% of the compound used with a conventional buff.

OTHER ADVANTAGES

The AIRWAY requires no raking, has a very fast cut and does not ridge the work. It is clean because there are no cross threads to pull out and the composition stays on the buff.

It has a wide face and usually two sections are equivalent to four of the conventional buffs. This should be considered when comparing prices with conventional buffs.

WARNING NOTICE

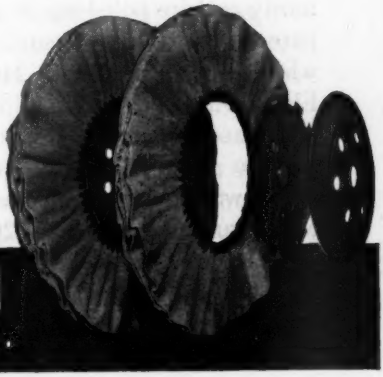
Jackson Buff Corporation of Long Island City, New York, has rights to U. S. Patents Nos. Re 19,894 and 2,140,208 which have broad claims covering an air-cooled buff having means for the admission of air through the sides of the buff. Owner intends to protect these rights and to stop infringement.

MATERIAL USED

Special sheeting used for cutting or coloring as your requirements demand. All bias cut, no ravel, no waste, no dirt.

Center plates and flanges made to suit the customer's spindle diameters.

Write us direct for samples or get in touch with a Licensed Jobber or Distributor.



CORPORATION

LONG ISLAND CITY, N.Y.

Finishing Base Metal Die Castings

By J. E. CHARLESON
Member Bridgeport Branch

Read before Hartford Regional Meeting, May 1939

As in the case of all other metals, the successful finishing of zinc base die castings begins in the Design Department. In designing die cast parts which are to be plated, an effort is made to eliminate, as far as possible, all flat surfaces and sharp angles. When these factors are not taken into consideration it is generally necessary to resort to polishing operations which might have been avoided with more thoughtful designing. Aside from the cost of finishing, there is always the danger of removing the dense surface and opening up the porous subsurface of the castings.

Equally important, if not more so, is the composition of the base metal. Only the highest grade metals obtainable on a commercial basis are used and the re-melting of plated scrap is not practiced. Very small amounts of cadmium, tin or lead will cause excessive internal growth and subsequent failure of plated castings, for which the plater may be blamed but over which he has little or no control. Dies and castings are inspected frequently in order to produce castings which will present a dense and smooth surface as the condition of the surface is very important in the cost of finishing.

Die castings produced under satisfactory conditions will ordinarily require polishing or grinding to remove parting lines and gate stubs. This is usually done on the regular soft polishing wheel using from 120 to 240 mesh abrasives as may be required. Flat surfaces are polished on side faced block wheels. The use of greaseless compounds on regular loose buffs is sometimes used to great advantage in cutting away minor surface defects which would not be removed in buffing. For this purpose, a 12″ wheel running at about 2000 RPM seems to give the most satisfactory results. One advantage in the use of this method is that almost any shape casting can be prepared for buffing by men with little or no polishing experience. Buffing is generally done

on loose or sewed buffs, using a free cutting tripoli to avoid excessive pressure, and then brought to a high luster with the usual lime compositions. For certain classes of work the cut buff and coloring operation is done in one operation in which tripoli is applied to one half of the wheel and the other half left dry. For hand buffing the recommended speeds are about 6500 ft. per minute. However, much higher speeds are being used and in some cases reach as high as 12,000 ft. per minute. For buffing on automatic machine of the rigid type, when it is necessary to use sewed buffs, speeds of over 6500 ft. per minute are avoided if possible while for loose buffs, 12,000 ft. per minute can be used. Whenever possible work is spun while in contact with the buffing wheels to eliminate dragging.

The cleaning of die castings is accomplished by vapor degreasing followed by alkaline cleaning and an acid dip. If zinc is to be cleaned in a degreaser used also for the removal of tripoli from brass or bronze, precautions must be taken to keep the solvent free from copper in solution. In the buffing of brass or bronze, with stearic acid compounds, some of the stearic acid reacts with the copper to form copper sterate, which in turn is soluble in trichlorethylene, the most common solvent used. If zinc is placed in the boiling chamber it will be completely copper plated when removed. This can be prevented by keeping a quantity of scrap zinc at the bottom of the boiling chamber. When it is coated with copper it must be replaced with clean scrap.

If work has been degreased, trisodium phosphate or one of the silicates at 4 ozs. per gal. give satisfactory results when used as electro cleaners and held just below the boiling point. If degreasing is not employed in the cleaning cycle, one of the prepared cleaners designed for zinc will in most cases be found to be more satisfactory. The acid dip used is the usual 5 to 10% hydrochloric acid. Care is taken to allow the zinc to remain in the acid only long enough to start gassing and usually only takes about 5 seconds. When withdrawn from the acid the zinc should have not more than a slight grayish appearance. It is our practice to empty the cleaning tanks each week and make up fresh cleaners and although it is true that the full life of the cleaner has not been utilized, we feel that the assurance of uncontaminated cleaners

of known strength at all times justifies the small increase in cleaner cost. In setting up tanks for cleaning and rinsing before and after plating we make it a point to keep the tanks as small as is practically possible. The reason for this being that a small volume of rinse water fed by a rapid stream of water is much more efficient than a larger volume fed by the same stream, as the water in a small tank is renewed at a faster rate and is therefore freer from contamination.

For plating nickel direct we use a sulphate bath of the following composition:

Nickel Sulphate	14 oz/gal.
Sodium Sulphate	22 oz/gal.
Ammonium Chloride	4 oz/gal.
Boric Acid	3 oz/gal.
pH	5.8 to 6.0
Temperature	85 degrees F.
Current density	about 25 Amp/sq. ft.
Cathode agitation	16 ft/min.

The operating conditions for this type of bath must be kept under rather close control for best results. If the temperature drops much below 75 degrees F., the deposits become brittle while above 90 degrees F., black streaking in recesses will result. In the normal operation of this bath the solution tends to go alkaline quite rapidly, making it necessary to correct the pH twice each day. If the pH is allowed to go over 6.2, basic nickel salts will most likely be deposited on the work. An indication of this condition is pitting, which cannot be overcome by an addition of hydrogen peroxide. In 600 gal. tanks we find it necessary to add a pint of H_2SO_4 each day to maintain the desired pH value. When movable cathode bars are used it is necessary to have very positive contact between the work and rack or peeling will result and for this reason we use clamp or spring contacts whenever plating nickel directly on zinc.

Nickel solutions used for zinc always accumulate zinc in solution and at a certain point it becomes impossible to operate the bath successfully. It has been our experience that chemical methods of analysis for small amounts of zinc in nickel solutions are unreliable and in most cases the plater must learn by experience when purification is necessary. The first indication of excessive

zinc is generally noted by the appearance of black streaks and an apparent reduction of throwing power at the usual voltage used. This condition can be overcome to a certain extent by increasing the current density and by the addition of sodium sulphate. As this process is continued the point will be reached where the deposits will crack and peel, at which point the solution must be purified. Of the several methods for the removal of zinc we prefer the basic carbonate treatment and as this treatment is so well known it will not be repeated here.

Heavy deposits of nickel cannot be satisfactorily plated on zinc from a sulphate bath. If the bath is free from zinc and well controlled, .0005″ or .0006″ can be safely deposited. When the solution picks up a little zinc this is no longer possible as cracking or peeling is almost certain to be encountered. This cracking or peeling may not appear when the work is withdrawn from the nickel tank. It may appear immediately after chrome plating or it may not take place until after the parts are placed in service. We make it a rule never to attempt to deposit over .0003″ of nickel directly on zinc and where heavier deposits are required the copper nickel deposits are used. When it is desired to copper plate prior to nickel, the choice of bath must, of course, depend on the results desired and may range from baths of high metal content at 100 degrees F. to low metal bath operated at 180 degrees F.

For depositing .0005″ of copper that does not require buffing before nickel, we use the following:

Metallic copper	2 oz/gal.
Rochelle salts	8 oz/gal.
Free Cyanide	.50 oz/gal.
Sodium Carbonate	8 oz/gal.
Temperature	140 degrees F.
Current density	about 40 Amp/sq. ft.
Cathode agitation	16 ft/min.

This bath has a very high throwing power and a rather low cathode efficiency with a maximum of about 40%. In order to keep the metal content controlled, a considerable portion of the anode surface is steel. In the absence of carbonates the anodes polarization is very great. When a bath of this type is first made

up it can be operated at 140 degrees F. for a period of a few weeks without causing fumes, but after which time it is necessary to erect blowers to carry the fumes away or it would be impossible to work over them. After copper plating, the work is rinsed in cold water, dipped in 10% sulphuric acid, rinsed in water and transferred to a regular Watts nickel bath at 115 degrees F.

Chromium is always plated over nickel as a base and the deposition of chromium directly on zinc is not practiced. In our German plant, where the use of nickel is restricted, we chrome plate a great many die castings, using brass plate as a base. In the plating of bright nickel over .0005″ of unbuffed copper, we were not successful. This, of course, had nothing to do with the nickel bath. The failure was due to the fact that at .0005″ the copper was neither smooth or bright enough. The best we could do with bright nickel over unbuffed copper was .0003″ of copper followed by .001″ of bright nickel which was necessary to obtain the desired brightness satisfactory for chrome plating.

Die castings are plated with cadmium, brass or bronze in the conventional solutions and no special precautions are necessary except in the case of cadmium, where lower current densities are used to avoid blistering. After plating with brass or bronze all work is wet scratch brushed to simplify subsequent finishing operations and to lessen the danger of cutting through while buffing. Many small parts are barrel plated with cadmium, copper, brass and bronze in conventional solutions and no special precautions are necessary. If design permits, die castings are sand rolled to remove burrs, and if desired they can be steel ball rolled, using the same procedure as for small brass parts, except that the time is shorter. As a general rule the time seldom exceeds 1 hour before plating and 15 minutes after plating, using a neutral soap. Oxidizing of plated zinc parts is carried on in the regular oxidizing solutions. The only precaution taken is to have the deposit thick enough to prevent the solutions from reaching the base metal. A thickness of about .0003″ of copper, brass, or bronze seems to give satisfactory results.

Many die castings are finished in baked japan, baked enamels and air dry lacquer enamels. As is well known, lacquers and

enamels do not adhere well to zinc and it is generally necessary to treat the surface to obtain proper adhesion. When treatment is necessary, either sandblasting or bonderizing is used. As a general rule, sandblasting is used for baked finishes and bonderizing for air dry lacquer enamels. Bonderizing is carried on in a regular bonderite bath in barrels or on racks as required. In treating zinc in this manner care must be taken not to allow the parts to remain in the solution too long or the surface will become very rough and a satisfactory final finish almost impossible. Parts should remain in the solution only long enough to change the color a slate gray and should not exceed three minutes.

It should be acknowledged, however, that there are certain types of enamels that do not require any treatment to obtain satisfactory adhesion.

A great deal of stress has been placed on the absorption of copper, brass and bronze deposits by zinc. If plated die castings are to be subjected to elevated temperatures there is no doubt but what this tendency is very great and must be taken into consideration as the rate of absorption is quite rapid under these conditions. The great majority of zinc die castings, however, are used at normal temperatures in which case the rate of absorption is very slow. Deposits of .0001" of copper, brass and bronze kept in storage for five years showed no visual effects of absorption.

Although copper seems to be the universal under coat for nickel it has been our experience that brass or bronze is satisfactory for ordinary purposes if one desires to use them.

The field of finishes that can be applied to die castings is in no way limited, as practically any desired finish can be obtained. In spite of the rapid advancement made in the production of die castings, the purity of the base metals and in finishing technique we should remember that they are still zinc base die castings and the writer is of the opinion that we expect too much of them in some cases. This paper was intended to give a general idea of the methods we use for finishing die castings and some of the conclusions we have drawn over a period of years, and any criticism or suggestions will be appreciated.

Business and Social News

BRANCH NEWS

Educational Activities

WATERBURY BRANCH

The Waterbury Branch held a business meeting on Friday, June 9th, at the Hotel Elton. The meeting was called to order at 8:00 P. M. by President Candee.

A plan was submitted and approved that there be a separate meeting each month to be held on the fourth Friday. The purpose of this is to save time on the regular meeting night so as to clear the way for the guest speaker.

It was also voted to rescind the plan adopted two years ago to defray part of the expenses of the Branch President to the annual convention. The plan had never actually been put into effect.

President Candee appointed the following as a membership committee: Tennant Elwin, Chairman; William Gray, Richard Crane, Henry Mahlstedt.

Earl Ball was appointed to call on any sick member and take care of other fraternal activities.

Plans were discussed for activities for the coming year, including the possibility of having a Branch picnic in September. Details will be announced later.

GEORGE MUSCIO, *Sec.*

SPRINGFIELD BRANCH

The regular monthly meeting of the Springfield Branch was held at the Hotel Charles on Monday, May 22nd at 8:00 P. M. The meeting was called to order by President Costigan.

The minutes of the previous meeting were read and approved. The secretary presented a bill from the secretary of the Hartford branch for $14.82 to cover our share of the deficit of the Regional Convention. The bill was voted paid.

Mr. Kennedy described the plans for the International Convention in Asbury Park and urged every member to try and attend. The following delegates were elected to the Convention, Messrs. Sager, Seidel and Barrus. The alternates elected were Messrs. T. J. Murray, Stevens and Delarm.

Mr. C. Hastie read the report of the nominating committee and the following officers were unanimously elected: President, J. E. Costigan; Vice President, C. Hastie; Secretary-Treasurer, D. S. Hartshorn, Jr.; Librarian, F. J. Clark; Board of Directors, A. A. Copp, T. Stephenson and W. Seidel.

President Costigan then introduced Mr. R. H. McCahan of the Electroplating Division of the E. I. du Pont de Nemours Co., who gave a very interesting talk on "High Speed Copper Plating". The talk was followed by a lively discussion.

The last feature of the evening's program was a showing of the du Pont sound film, "The Wonder World of Chemistry". The picture described the various chemical products which are being made of many common place materials such as cotton, corn, oil, water etc. The picture was very interesting and instructive and provided an enjoyable contrast to the rest of the program.

Mr. McCahan was given a rising vote of thanks for his assistance in providing such an excellent program.

The meeting was adjourned at 10:45.

D. S. HARTSHORN, JR., *Sec.-Treas.*

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MILWAUKEE BRANCH

The Milwaukee Branch A. E. S., held their regular meeting at the Republican Hotel on Thursday, June 1st. Roll call of Officers found all present. Minutes of the previous meeting were read and approved of. It was moved and seconded that all bills be allowed.

Communications pertaining to the Convention, Hotel Ads, etc., were read and placed on file.

Henry Bornitzke, Secretary of the Chemistry Class that was sponsored through-out the winter by the Branch gave his report that the class was a huge success starting with 15 members and rising to 24. The Class had an average attendance through-out the season of 17 members.

R. M. Goodsell had charge of the installation of the new officers for the coming year.

A motion was made and seconded that the Board of Managers draw up a Budget to be submitted to the Branch to be used for the running and maintenance of the Branch for the year '39 and '40.

Under the good of the order, a motion was made and seconded that the Branch dispense with their regular July and August meetings. This motion was carried.

Meeting adjourned at 9:45 P. M. for refreshments.

ROBERT B. GOODSELL, *Sec- Treas.*

CHICAGO BRANCH

The regular monthly meeting of the Chicago Branch was held on June 10, 1939 at the Atlantic Hotel. President J. W. Hanlon presiding, and all other officers present except the Librarian, Mr. O. Weickmann.

As the representatives of some of the Railroads were at the meeting to tell the Branch their rates and routes to Asbury Park, N. J., they were given the floor before the business session started. Mr. H. A. Gilbertson was given a rising vote of thanks for his fine work of acquiring information on the travelling accomodations by rail, bus and air.

The acting Librarian, Mr. O. E. Servis introduced Mr. G. Soderburg who gave a very interesting talk illustrated with slides on "Special Cadmium Baths". The discussion was lengthly and the questions were answered intelligently and accurate as Mr. Soderberg does at all times. The Branch gave a rising vote of thanks to him for his fine talk.

The following questions were in the question box.

Q. Is it necessary to prepare the inside of a lead lined chrome tank to prevent perforating?

A. It is not necessary, but if the tank is made anode for a few hours an insoluble lead peroxide will form that is insoluble in the chrome solution.

Q. What is the cause and cure for chipping oxide?

A. Solution is probably too old, make a new one.

Mr. O. E. Servis was asked to install the new officers for the coming year, and he did so in his very unique way which was not only instructive but a pleasure to the Officers and the Branch.

A motion was carried to adjourn, for the refreshments were ready to serve. A joyful gathering of members and friends was enjoyed the remainder of the evening.

Reinstatement: E. W. Griese, 1638 N. Tripp Ave., Chicago, Ill.

M. H. LONGFIELD, *Sec.*

PHILADELPHIA BRANCH

Philadelphia Branch meeting called to order by Pres. Joe. E. Underwood. Roll call of officers showed one absent

due to sickness. Minutes of previous meeting read and approved. Executive Secretary W. J. R. Kennedy honored Philadelphia Branch by his presence; was called upon to speak and gave a very interesting talk on the workings of the Supreme Society; also thanked the members for the cooperation they had given the Officers this past year in increasing the membership in the manner they had. Mr. Kennedy was given a rising vote of thanks.

Mr. Zurbach and D. Robson then gave a very interesting talk on the residue in a "Brass Solution". They promise to have a paper on this subject later. After a very interesting discussion Messrs. Robson and Zurbach were given a rising vote of thanks for their very able talk. Mr. S. S. Johnson's application for associate membership and Mr. Mathias Foggarty's for active membership were referred to Board of Managers for investigation. Regarding communication from Milwaukee Branch as to Amendment to Constitution, delegates were instructed to vote against the amendment. Entertainment Committee reported progress.

President appointed John Nelson; Klunk; P. Mentzer; G. Racine on the election board. Moved and seconded where there is no opposition the Secretary be instructed to cast the unanimous vote, carried. Election Board reported the following officers elected.

President, Joe. E. Underwood; Vice-President, L. A. Critchfield; Secretary-Treasurer, Robert E. Jackson, Jr.; Librarian, E. J. Zurbach, Jr.; Board of Managers, George Gehling; George Long; Al. Hirsch; Delegates, Joe. E. Underwood; E. J. Zurbach, Jr.; Fred Fulforth; Alternates, George Racine; Harry Shelly; P. Mentzer.

President Underwood called upon Executive Secretary, W. J. R. Kennedy to install the newly elected Officers.

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Mr. Kennedy was impressed and stressed the fact that the Board of Managers were all past Presidents of Philadelphia Branch; which is a good omen as they are all active and work hard for the welfare of the Society.

Report of Board of Manager's Audit of Secretary-Treasurer's Books read, moved same be accepted and placed on minutes, carried. There being no further business, meeting adjourned until June 23, 1939 at Harrison Laboratory U. of P., 34th and Spruce Sts., Philadelphia, Penn.

ROBERT E. JACKSON, JR., *Sec-Treas.*

CLEVELAND BRANCH

The regular meeting of the Cleveland Branch was held Saturday evening, June 3rd, 1939 in the Hotel Cleveland. Meeting was called to order at

8:15 P. M., by President Matts, with an attendance of 34.

The minutes of the meeting of May 6th were approved as read. The applications for associate membership were received from Harold L. Trambicki, of the Cowles Detergent Co. and Chester B. Potter, of the Potter Cleveland Supply Co. These were referred to the Board of Managers.

Howard Henry Blouch, of the Dupont Co. was elected as an associate member and Burt Frank Braddock, of the Hodell Chain Co. was elected as an active member.

Mr. Singler, as Chairman of the Picnic Committee, reported that everything was ready to go on Saturday, July 15th. He said that all they needed now was some good weather and a little training for Bill O'Berg's pitching arm.

Chairman Scott, of the Silver Jubilee Committee, reported that he had selected Messrs. Singler, O'Berg and Binder to serve with him. He further reported that information on entertainment, etc. was being gathered from various sources and would be digested by the Committee and reported upon soon.

Chairman Truden, of the Regional Meeting Committee, reported that considerable progress was being made toward having such an affair.

Mr. Geo. B. Svenson, of the Platers Supply Co., presented a transfer from the Pittsburgh Branch and was welcomed into membership in the Cleveland Branch by President Matts.

Following our usual custom, there will be no meeting of the Cleveland Branch in July. This is due to the fact that our meeting falls on the holiday week-end.

In view of the fact that the Secretary has a number of copies of the 1938 Convention Proceedings still uncalled for, it was decided to offer these volumes to our newly elected members. This idea certainly met with the approval of the new members.

It is with a great deal of regret that Cleveland Branch accepts the resignation of Mr. L. F. Koehle. Lew has been an active and faithful member of Cleveland Branch since almost the beginning. We sincerely hope he will not forget us and will still come up and visit the Branch from time to time.

The Secretary was instructed to produce, at the August meeting, a list of the members who are delinquent in their dues.

Mr. R. O. Hull, of the Graselli Chemical Co. announced that he had been approached by the John Huntington Polytechnical Institute of Cleveland to conduct a lecture course in electroplating this fall. As this is an

endowed institution, no tuition would be required for enrollment.

Cleveland Branch was very pleased to welcome Mr. MacDermid as a visitor from Hartford Branch. Mr. MacDermid responded humorously to President Matt's welcome, boosting the Convention and the New York World's Fair.

Librarian Truden announced that the J. J. Siefen Co. would furnish the speaker for the August meeting. The subject to be "Abrasive Bond".

The meeting adjourned for refreshments at 9:30 P. M.

P. R. LYONS, *Sec.-Treas.*

MONTREAL BRANCH

The Montreal Branch of the A.E.S., held its regular monthly meeting on May 25th at the New Carleton Hotel.

The meeting was called to order at 8:15 P. M., roll call showing record attendance.

The application for active membership of Mr. E. H. Marsh, Union Screen Plate Co., Lennoxville, Quebec, was read and accepted.

Reports from retiring president and secretary proved satisfactory, showing that the Montreal Branch has grown in health during past year, both as to new members and financial condition.

The elected officers for the coming year are as follows:-President, Mr. C. Doherty; Vice President, Mr. H. Harding; Treasurer, Mr. R. Gordon; Secretary, A. W. Jerome; Librarian, Mr. H. S. Jordan; Board of Managers, Messrs. C. Douglas, E. Creighton and J. T. Reisenburg. The delegates to the Convention are Messrs. J. H. Feeley, H. S. Jordan and H. Harding, the alternates; R. Gordon, C. Doherty and A. Willis.

A. W. Jerome was elected to the secretaryship upon the resignation from that office of J. T. Cronin who due to pressing business activities found it impossible to fulfill his responsibilities in the capacity of secretary.

The retiring officers were given a rising vote of thanks for their cooperation during the year.

The topic for the rest of the evening was the coming convention which kept the members in discussion till 11:15 P. M. when meeting was adjourned.

A. W. JEROME, *Sec.*

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Full Disc - Loose - or Sewed

Thousands of every size

8"—8¢ each 9"—9¢ each

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DETROIT BRANCH QUESTION BOX

1. *Is there any adhesive, cement, or gum that can be used in the polishing industry for setting up wheels and straps which is as satisfactory, as economical, and as efficient as hide glue?*

A. A number of the members are successfully using a silicate base synthetic adhesive for this purpose. It was pointed out that these synthetic

cements are more satisfactory when used with the coarser grains then with very fine grain. When the synthetic cements are used, there is more tendency for the wheel to cut and less tendency to glaze.

Q. It is desired to plate heavy non-adherent coat of copper over zinc base die cast in such a way that the copper coating may be peeled off from the die casting without breaking or tearing. Are there any suggestions?

A. One suggestion was to passivate the surface of the die casting with chromic acid and then plate in cyanide copper in the usual way. Other suggestions were immersion in an acid copper solution; immersion in a nickel plating solution; or an intentionally poor rinse following the cleaner.

It was pointed out that if the first method were used in production, the copper plating solution might become contaminated with chromic acid.

Q. There is a grease stick available containing ground charcoal which is supposed to take the place of emery cake. Has anyone had any experience with this? Is it likely that it may create a form of carbon smut from residual carbon or by pick up from the cleaner bath?

A. There was no positive answer forthcoming, but it was stated that charcoal had been used for many years in polishing cast iron without apparently increasing the smut problem. It seems doubtful if particles of charcoal from the grease stick would be as difficult to remove as the well known carbon smut.

Q. Is it possible to convect two 3000 *amp. generators and one* 6000 *amp. generator to one tank to obtain* 12000 *amps?*

A. The direct answer is yes.

If the fields have similar characteristics, the generators can be connected in parallel with a common bus bar leading to the tank. The armatures should be rotating and the three fields cut in simultaneously to prevent one generator from shorting through another. A voltage regulator could be used on each generator but the lag might be too great to obtain maximum efficiency.

Another suggestion was to divide the anode rod of the tank and the sections corresponding in length and number to the ampere capacity and number of generators to be employed. A common lead from all generators to the cathode rod and separate leads from the positive poles of the generators to their respective anode rod sections will prevent any possibility of broken contact. One member stated that he had operated a bright nickel plating solution with more than one generator in a very satisfactory manner.

R. B. SALTONSTALL

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ANDERSON BRANCH

The Anderson Branch of the A.E.S., held their regular monthly dinner meeting at the Y.M.C.A. on Tuesday, June 13, 1939 at 6:30 P. M.

Dr. D. A. Cotton gave a preview of his paper that he is to present at the coming convention. The title of the paper was "Chrome Plating of Dies and Gauges". Dr. Cotton has had a great deal of experience along this line with the Delco Remy Division of General Motors and has saved a considerable amount of money through the process that he has developed. One of the main points brought out by Dr. Cotton was the small amount of equipment necessary to carry on this work. He also gave several examples whereby he has been able to save his company large amounts of money as well as a great deal of production time. He also went into detail on the process he has developed and it was especially interesting to those members of the branch who had had previous experience along this line. Dr. Cotton was very liberal in his praise of Mr. C. H. Bonge, another member of our branch, for his work in helping to develop this process. After Dr. Cotton's talk many questions were brought up and discussed.

Dr. Cotton has brought considerable recognition to the Anderson Branch with the papers that he has presented at the conventions in the past and we feel that this will be no exception. The Anderson Branch is wishing Dr. Cotton the best of luck in the presentation of his paper at the convention, but somehow we feel that he will not have to depend very much on luck.

The branch was favored by many welcome guests at this meeting, among them being Mr. E. T. Ranson of the Aluminum Finishing Corp. of Indianapolis, Ind. We enjoyed their presence and hope to see them again at future meetings.

The following was found in the question box.

Q. Would such products as Dreft and Vel have any commercial use in the plating industry?

A. Yes. The Dupanol products used at the present time are very similar. Each has the property of reducing the surface tension. It is also used extensively in the manufacture of brighteners for bright nickel.

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TOLEDO BRANCH

Minutes of regular June meeting, June 1st.

A regular meeting of the Toledo branch, of the A.E.S., was called to order at 8:30 o'clock P. M. at the home of Henry Schuldt, by our President Victor Miner.

The minutes were read and approved, all communciations were read and acted on, regarding the convention exhibits, the secretary was asked to try and get at least one exhibit to take to the convention, and Mr. Wieker was instructed to write Mr. Kennedy accordingly.

At this time the board of managers placed the application of Chas. T. Vannorsdall for an associate member, before the members, a motion by Mr. Cope to accept the application was unanimously passed. The board also instructed the secretary to send each member a copy of the suggestions offered by the board, for the betterment of the branch, for their consideration, before the next meeting.

Mr. Hale was asked to have some cards and envelopes printed, which he said he would do.

Question Box

Q. What causes discoloration on chrome deposits over brass?

A. Poor current distribution.

Q. Does the addition of peroxide cause the p H to go up?

A. No.

Q. How can you plate stainless steel?

A. Give silver stike first then ni.

Meeting adjourned at 10:15 o'clock, after which the Chevrolet Co. showed some sound pictures. After the pictures refreshments were served.

G. H. BERGEMAN, *Sec.*

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ROCHESTER BRANCH

It is with regret that we announce the death on Tuesday May 16, 1939 of Mr. Arthur Mayer of 7 Reed Park, Rochester, N. Y. The members of the Rochester Branch extend sympathy and condolences to the members of his family.

On Friday night, June 16, the Rochester Branch held its regular monthly meeting at the Seneca Hotel. Meeting was called to order by President DelRosso.

A regular business meeting was held during which the Delegates to the Convention were instructed to vote against the Milwaukee amendment. Secretary instructed to notify those in arrears in their dues, of a deadline for the payment of these back dues, if they do not wish to be suspended.

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The application of Mr. Lyndon H. Welles, 64 Brunswick St., Rochester, New York as an associate member was then read and ordered published. The chairman of the exhibit committee, Mr. Henry Cameron, then reported that Rochester was to be represented by two nice exhibits.

A letter was read from Mr. Joseph Ruff, President of the Buffalo Branch, inviting our branch to hold a joint picnic, which was accepted on motion of Mr. McGuire, seconded by Mr. Lux. The president was ordered to appoint a committee to work in conjunction with Buffalo Branch. Mr. G. A. Lux was appointed chairman with the following assistants, Mr. Fred Bruening, Mr. Cecil Trembicki, Mr. Ray Berghold and Mr. Judson Elster.

The meeting was then turned over to a discussion period during which Mr. Henry Cameron asked if anyone had had trouble in a bright nickel bath with soldered racks and how to eliminate this trouble.

Mr. Hendershott suggested the use of a fluoboric acid dip to dissolve the loose lead salts making the lead free so as to rinse off leaving a hard or passive surface and keeping the lead out of the solution. After a little more discussion the meeting was adjourned.

JUDSON R. ELSTER, *Sec'y*

PHILADELPHIA BRANCH

Philadelphia Branch meeting called to order by President Joe E. Underwood. Roll call of Officers showed all present. Minutes of previous meeting read and approved.

Application of Mr. George T. McLintock for active membership referred to Board of Managers. Applications of Mathias Foggarty as active membership and S. Johnston as associate membership reported favorable by Board of Managers, motion made and seconded that applicants be elected to their respective classification as members of Philadelphia Branch was carried.

President Joe. E. Underwood gave a very interesting report of the Branch — thanked the members for their co-operation and also desires to have the members give the Officers the same co-operation this year.

Reports of the Delegates, Joe E. Underwood, Fred Fulforth and E. J. Zurbach, Jr., proved very interesting, especially E. J. Zurbach Jr's, report as to the Educational Sessions, brief also covering a great deal of ground. Moved and seconded delegates be given a rising vote of thanks, carried.

Mr. Phil Uhl thanked the Branch for their efforts in having him elected as Honorary Member of Supreme Society.

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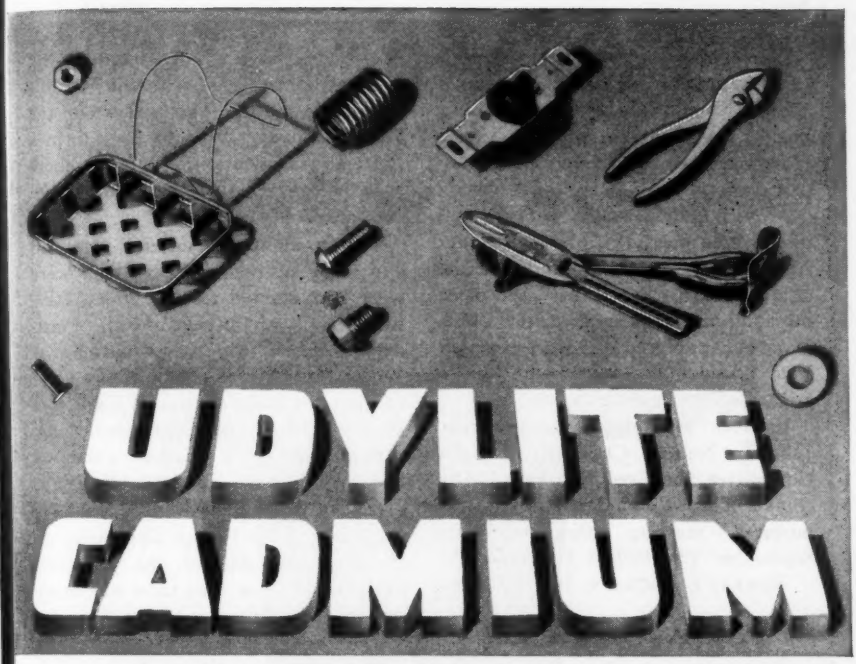

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Moved and seconded that Secretary be instructed to place the name of George Gehling before the Supreme Society for consideration to election as Honorary Member of Supreme Society, carried.

Moved and seconded that Branch discontinue meetings during July and August, carried. Moved and seconded Branch hold its September 22nd meeting at Lancaster, Penna., and a Chairman be appointed for same, carried. Vice President L. A. Critchfield was appointed chairman for same.

President Underwood also appointed John L. Nelson, Chairman Banquet Committee and Fred Fulforth, Editor Quaker City Reminder. No further business, meeting adjourned until September 22, 1939 at Lancaster Pa.

ROBERT E. JACKSON, JR, *Sec.-Treas.*

TORONTO BRANCH

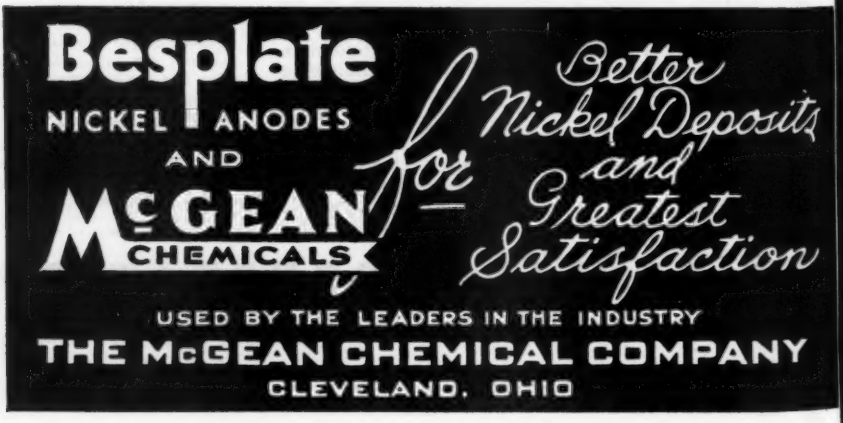
Toronto Branch met on June 26 at King Edward Hotel. President Acheson opened the meeting and appointed Tom Boaz to act as vice chairman in the absence of Archie Smith. After the reading of the minutes, bills, etc., Jack Walker who was a delegate at the Convention was asked for his report of the proceedings. Jack attended all sessions, finishing up with the World's Fair in New York. This was one of the best reports ever brought back from a Platers' Convention; the members showing appreciation by a hearty vote of thanks.

Twenty-eight Canadians attended and some of the members who were with Jack started talking about Dayton, Ohio a whole year ahead. President Acheson who was Chairman at one of the sessions spoke of the Convention as a great success and was sure all who attended were delighted. Tom O'Keefe and Jack Walker started a discussion about the World's Fair.

It was pleasing to note in the June issue that John Feeley was made an Honorary Member of the Montreal Branch and since that time was made an Honorary Member of the Supreme Society at the last Asbury Park Convention. Congratulations, John.

Mr. Cronin was kind enough to mention the same event which took place a year ago with Walter Barrows, both men receiving honor and a presentation of profound gratitude on the part of the membership.

J. S. CAIRNS, *Rec. Cor.*



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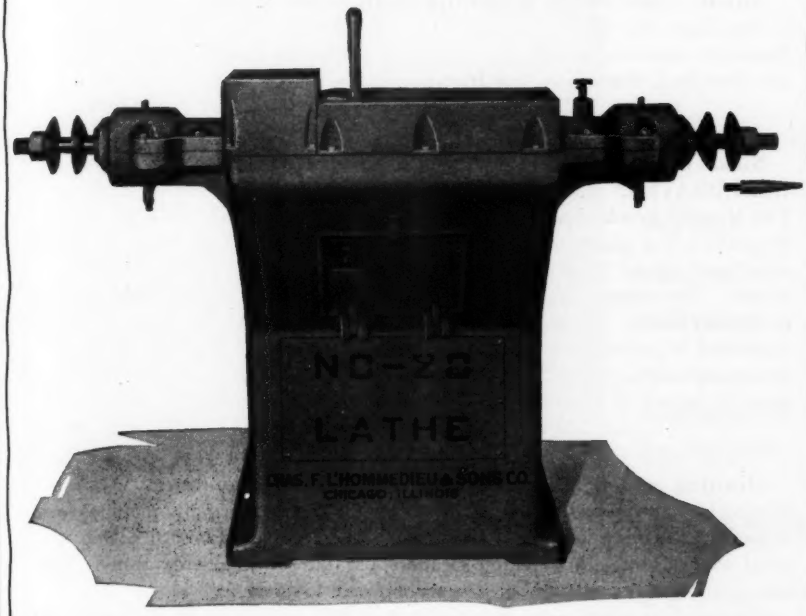

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The Abstract Section

FREDERICK FULFORTH, *Chairman, Program and Educational Committee*

Anodic Films on Tin in Sodium Hydroxide Solutions. By R. KERR. *J. Soc. Chem. Ind.* **57,** 405-10 (1938); *Chemical Abstracts* **33,** 1601 (1939). Films formed by anodizing tin in sodium hydroxide solutions under various conditions are described. Some films may be dyed.

ERNEST H. LYONS, JR.

Nickel Chrome Plating on Tin Plate. A. W. HOTHERSALL and C. J. LEADBEATER. *Sheet Metal Ind.* **12,** 1379 (1938); cf. Abstract Section, *The Monthly Review American Electroplaters' Society,* January 1939, p. 72. The tin plate is first plated with a thin film of cooper from a cyanide bath. This is rinsed and dipped in a potassium acid tartrate or acid citrate solution and again rinsed. The copper plate is covered with a 0.00025" nickel plate which is then chromium plated. In order to insure adherent plates, the tin plate should be degreased in an organic solvent and treated cathodically in 5% sodium carbonate solution at 140°F. at a current density of 50 amps./sq.ft. After 5 minutes the current is reversed for 1-2 minutes. IVER IGELSRUD

Chemical Abstracts **33,** 2418 (1939).

Cleaning and Brightening Copper and Brass. A. Darlay. *Galvano* (Paris) Jan. and Feb. 1939. Cleaning brass for plating normally includes four steps; degreasing, pickling, whitening and brightening. For degreasing, the usual methods including alkaline cleaners, organic solvents, etc., apply. This step is sometimes omitted, but it is seldom wise to do so.

Pickling to remove oxides is carried out in 10% sulfuric acid. This step too is often not taken, but is advised for economy and for better results with the nitric acid dips whenever oxide is present.

The first dip may vary with the nature of the work. Typical formulas are:

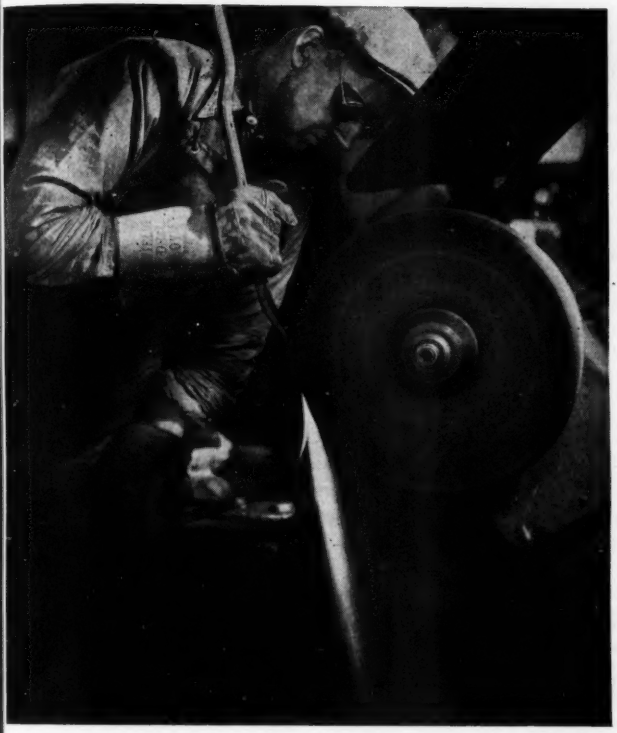
(a)
Nitirc Acid 36° B	— 1 liter
Sodium Chloride	— 20 gr.
Soot	— 20 gr.

(b)
Nitric Acid 36° B	— 1 litre
Hydrochloric Acid	— 10 cc.
Soot	— 20 gr.

(c)
Sulfuric Acid 66° B	— 80 gr.
Sodium Bichromate	— 60 gr.
Water	— 1 litre

The final bright dip requires the most care. The strength and ratio of the acids used varies widely in practice. From experience, an excess or deficiency of any of the acids used, that is, of nitric sulfuric, or hydrochloric acids, may be determined from observation of the work. Two American formulas, that of Graham, and that of Blum and Hogaboom, are given. Thorough rinsing, including a rinse in weak cyanide, is recommended.

C. T. THOMAS



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Electrolytic "Polishing" of Zinc. By W. H. J. VERNON and E. G. STROUD. *Nature* **142,** 1161 (1938); *Chemical Abstracts* **33,** 1601 (1939); cf. *Monthly Review American Electroplaters' Society*, March, 1939, p. 230. The data previously given apply only when the cell has a small resistance connected in parallel so that variations in anodic polarization have only negligible effects on cell voltage. ERNEST H. LYONS, JR.

Modern Processes of Electro-Zinc Deposition. By H. FISCHER and H. BAERMANN. *Korrosion u. Mettallschutz* **14,** 356-64 (1938); *Chemical Abstracts* **33,** 2042 (1939). Bright zinc baths give deposits equal to bright cadmium at lower cost with superior productive capacity. Zinc deposited at high current density resists the salt spray and immersion in 3% sodium chloride solution as well as cadmium, and excels cadmium in atmospheric exposure. Small amounts of mercury, lead, or cadmium in the zinc plate do not afford greater protection. Mercury may produce severe corrosion in contact with light alloys and should be avoided. The protection of zinc coatings is greatly enhanced by chromate after-treatment. Zinc deposits containing copper may be as hard as nickel plates, and are good undercoatings for chromium, affording superior resistance to tarnish. ERNEST H. LYONS, JR.

Anodically Oxidized Aluminum Alloys-Metallographic Examination. By F. KELLER and G. W. WILCOX, *Metals and Alloys*, June 1939, Page 187. The electrolytes commercially employed for producing anodic coatings contain chromic acid or sulphuric acid. The latter, however, is more popular in this country. The character of the deposits may be studied to an advantage by metallographic methods. Because cross sections of anodic coatings of aluminum and aluminum alloys do not reflect much light a new method for illuminating the samples has been devised. This method employs the use of reflected polarized light and considerably enlarges the scope of metallographic investigations. When viewed under reflected polarized light it is possible to determine which electrolyte was employed in anodizing, also whether the coating was sealed, and which method was employed. The authors also describe the examination of the anodic coating for the presence and condition of alloyed metals. D. S. HARTSHORN, JR.

The Electrodeposition of Nickel from Nickel Chloride Solutions. By W. A. WESLEY and J. W. CAREY. *Trans. Electrochemical Society,* **75** (preprint) (1939). Excellent nickel plates were obtained in the laboratory from nickel chloride baths, and the authors suggest that such baths would have come into general use except for their strong corrosiveness. Modern corrosion-resistant materials remove this objection. Advantages claimed for chloride baths over sulfate baths are: finer-grained deposits which are smoother, harder, less ductile, stronger, and easier to buff; only half as much voltage and power required; easier control and wider plating ranges; less pitting and treeing. The deposits afford as much protection from corrosion as those from the sulfate bath. A recommended composition is: nickel chloride, $NiCl_2.6H_2O$, 40 oz./gal.; boric acid, H_3BO_3, 4 oz./gal.; 130° F.; current density 100 amps./sq.ft.
ERNEST H. LYONS, JR.

DETROIT BRANCH SUMMER OUTING

The Detroit Branch of the American Electroplaters' Society will hold their annual picnic and Summer Get-to-Gether on Saturday, August 5th, at Sandy Mac's Golf Course. The all day outing will include golf in the morning, noon day lunch with the usual special dish of sweet corn, and events for prizes in the afternoon.

As the golf pitching contest was won with a driver last year, all drivers are barred this year.

The committee is now looking for several honest, upright, and steadfast men to act as umpires in the baseball game. Another requirement is that the umpires for the ball game be fast runners and good dodgers.

Members of other branches are cordially invited to attend this outing, and renew friendships with members of the Detroit Branch.

Mr. R. C. Enos, President of Standard Steel Spring Company, Coraopolis, announces the appointment of Thomas N. Berlage as Director of Sales for the Corronizing Division of the Company. Corronizing is a new process for coating steel for corrosion protection.

Mr. Berlage will assume his new duties with a rich background of sales experience with the Standard Engineering Company and the Shell Oil Company.

Mr. Berlage is a graduate of the Massachusetts Institute of Technology where he earned the degree of Bachelor of Science in Chemical Engineering. He is 38 years of age. His hobby is an 80 acre farm near Chicago.

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Porosity Test for Electrodeposited Coatings of Tin on Lead. By S. BAIER and T. P. HOAR. *J. Soc. Chem. Ind.* **58,** 69-74 (1939); *Chemical Abstracts* **33,** 3267 (1939). Tin coatings used to protect lead pipe from solution by soft water, can be tested for porosity by dipping in a solution of 50 g. ammonium acetate, and 10 g. potassium chromate in 1 liter distilled water. Lead chromate precipitates loosely around the pores, or an anodic current will develop adherent spots of brown PbO_2. ERNEST H. LYONS, JR.

New Patents. **Producing a Bright Finish on Copper-Zinc Alloys.** By VON GIESCHE'S ERBEN, G. *The Metal Industry,* London, England. Volume **LIV,** No. 21, May, 26, 1939. A bright finish is produced on copper-zinc alloys by pickling in a solution containing chromic acid and hydrochloric acid, rinsing, and then removing any coating or discoloration produced by the first solution by pickling in a solution containing chromic acid only. The articles are not degreased before treatment; the first solution preferably contains not less than 15 per cent by weight of chromium trioxide and not more than 15 per cent of hydrochloric acid, and the second solution preferably contains 10-70 per cent of chromic acid. The temperature of the solution must not exceed 30°C. ROBERT B. GOODSELL

Natures' Digest. **Nature of Films on Tin Anodes.** *The Metal Industry,* London, England. Volume **LIV,** No. 24, June 16, 1939. A copy of this publication may be obtained free of charge from the International Tin Research & Development Council, Fraser Road, Greenford, Middlesex, England.

Compositions and properties of the anodic films produced under all possible conditions are in this report Technical Publication #91, by Dr. R. Kerr.

Anodic films, such as are utilized in the alkaline stannate bath, are greenish yellow in the bath, but change to orange outside and also decompose. They consist principally of hydrated stannic oxide with some stannous oxide; they may be dyed for decorative purposes, and are completely soluble in alkalis. Brown films contain less stannous oxide, cannot be dyed, and are less chemically active, while black films have good resistance to moist air and hot water, and have decorative possibilities for tinplate and pewter.

ROBERT B. GOODSELL

The Electrodeposition of Bright Metal Deposits. By M. WITTUM. *Mitt. Forsch-Inst. Probieramts Edelmetalle staatl. höheren Fachschule schwäb. Gmünd* **12,** 67-75 (1938), 105-11 (1939). The economic advantages of producing bright deposits (elimination of polishing) are discussed. For a bright deposit it is necessary to obtain grains or crystals smaller than the wave length of light which is reflected. The grain size becomes smaller the lower the velocity of growth of the grains and the higher the velocity of initial grain formation. This can be done practically by disturbing the normal growth of the crystallites by introducing alien bodies of a larger molecular size than those of the metal, for instance colloids, either organic or inorganic. Then follows a review of U. S. and European bright-plating baths. M. HARTENHEIM

Chemical Abstract **33,** 4134 (1939).

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Brush Plating, *Iron Age* **143 #18,** May 4, 1939, p 39. Gives diagram showing relationship of time and thickness for plating .00025".

Electrotinning Strip Steel, *Nachtman Steel,* **104, #24,** June 12, 1939, pp 56-57. The author describes the electrotinning of steel sheets. In order to improve the luster of the deposit, it is passed through a hot oil bath at a temperature sufficient to fuse the tin and then the coating is quenched in a cold oil bath. This operation improves the drawing and forming qualities and reduces the porosity of the tin plate.

Chromium Plating Tractor Engine Parts for Wear Resistance, *Iron Age,* **143, #** 20, May 18, 1939, p 76. Parts are plated with a deposit of chromium in excess of .0005". The bath used consists of 33 oz./gal. chromic acid and .33 oz./gal. of sulfate. The temperature is maintained at 130 deg. F. The entire process is described in eight steps. DR. C. B. F. YOUNG

Determination of Formate and Sodium Thiosulfate in Silver Plating Baths. By M. ENGEL. *Mitt. Forsch.-Inst. Probieramts Edelmetalle staatl. höheren Fachschule schwäb. Gmünd* **12,** 95-8 (1939). Older cyanide silver-plating baths contain potassium formate and free ammonia which are formed by the hydrolysis of potassium cyanide according to the reaction $KCN + 2H_2O = HCOOK + NH_3$. Sodium thiosulfate is sometimes added to obtain brighter deposits. The formic acid is determined by titration of the soda-alkalized, hot solution with $\underline{N}$ or 0.1 $\underline{N}$ $KMnO_4$ until a pink color is obtained. The determination can also be made by oxidation of the formate solution; procedure is described. Sodium Thiosulfate cannot be determined in silver baths, as usual, by titration with iodine solution, but on the basis of the reaction $H_2S_2O_3 + H_2O = H_2S + H_2SO_4$. If the silver bath containing $Na_2S_2O_3$ is acidified (with acetic acid) and boiled, H_2S precipitates as silver sulfide, with silver cyanide and silver chloride. H_2SO_4 remaining as sulfate in solution is determined as barium sulfate. Detailed procedures in both cases are described as well as the determination of thiosulfate in the presence of sulfate. M. HARTENHEIM

Chemical Abstracts **33,** 4134 (1939).

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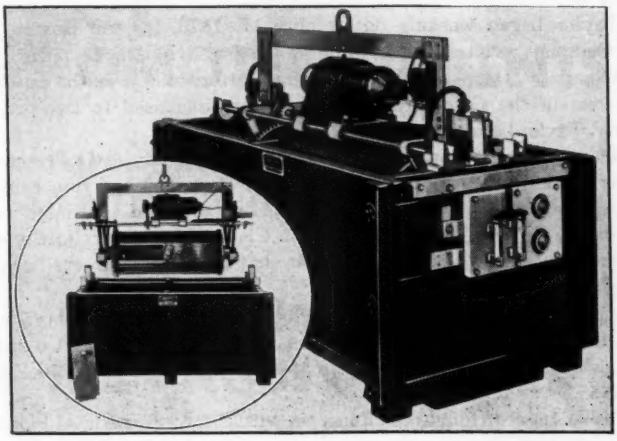

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CHARLES S. TAYLOR MADE HONORARY MEMBER OF THE A.E.S.

Charles S. Taylor, President and Treasurer of the Boston Nickel Plating Company, 160 Portland Street, Boston, Mass. who was recently elected an Honorary Member of the Supreme Society of the A.E.S. is known to be the dean of the jobbing electroplaters in the United States. He has the enviable record of having been with his company continuously for 65 years.

Mr. Taylor began working on October 17, 1870, for the Boston Nickel Plating Company as an errand boy and shop helper. He later became the plater for the Company, then the Superintendent. After some years he purchased a third intrest in the Company. This was later increased to two-thirds and finally Mr. Taylor became sole owner.

In 1909, the Company was incorporated with Mr. Taylor as President and Treasurer, and Charles F. Campbell as Vice President and Superintendent. In the early days of Mr. Taylor's plating experience, he was associated with Dr. Isaac Adams, George D. Allen and A. N. Clark, the pioneers in the electroplating industry in the United States. At that time the shop was licensed by the United Nickel Company.

At the present time, although Mr. Taylor is past his 83rd birthday, he is still active in the Boston Nickel Plating Co; as well as in the Medford Co-operative Bank of which he is President. (The above reprinted from *Metal Industry*, August 1935.)

Mr. Taylor retired from active business with the Boston Nickel Plating Co; on October 1, 1935, and now devotes his time to the duties of President of the Co-operative Bank. In his spare time he travels and gardens. His hobby now is divided between roses (a small rose garden containing about 140 plants) azaleas (about 30 plants) and rhododendrons. During the last year he enjoyed a trip to Alaska and also to Bermuda.

A brief outline of the others recently elected honorary members will follow.

LETTER OF THANKS

Prior to the 27th Annual Convention of the A.E.S., at Asbury Park, N. J., June 1939, the Plated-Ware Exhibit Committee of Newark, ran high spirited competition, shooting at a mark that has never been hit. For never in the history of A.E.S. conventions, has every branch been represented with a plated-ware exhibit.

Eager, the committee rejoiced, for the opening day of the convention, brought triumphant results. All 29 branches had cooperated, and exhibited articles that were legitimately plated by a member of each respective branch of the society.

In appreciation for the splendid support received from all branches, the Newark Branch Plated-Ware Exhibit Committee, joyfully express their very sincere thanks, for making the 100% plated-ware display possible. Thanks again.

PAUL A. OLDAM, *Chairman*
1939 Plated-Ware Exhibit Committee

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Membership Report

to July 1, 1939

APPLICATIONS

Chester B. Potter, 5245 Superior Ave., Cleveland, Ohio
Associate, Cleveland Branch

Harold L. Trambicki, Cowles Detergent Co., 10525 Carnegie Ave., Cleveland Ohio
Associate, Cleveland Branch

Richard J. Amberg, 832 Fisher Bldg., Detroit, Mich.
Associate, Detroit Branch

Frank H. Wilbur, 15717 Woodingham Dr., Detroit, Mich.
Active, Detroit Branch

Lyndon H. Welles, 64 Brunswick St., Rochester, N. Y.
Associate, Rochester Branch

Ross Newton, 1285 Harmon Ave., Hamilton Ohio Active, Cincinnati Branch

A. C. Simon, 2818 N. Fairfax Drive, Arlington, Va.
Associate, Baltimore-Washington Branch

Albert G. Dornblatt, National Bureau of Standards, Washington, D. C.
Associate, Baltimore-Washington Branch

ELECTIONS

Edward F. Hull, Long Hill Ave., Shelton, Conn.
Associate, Bridgeport Branch

Walter L. Sackett, 1239 Walnut St., Utica, N. Y.
Associate, Binghamton-Syracuse Branch

Bert F. Braddock, Hodell Chain Co., 9210 Holten Ave., Cleveland, Ohio
Active, Cleveland Branch

Howard H. Blouch, E. I. du Pont de Nemours & Co., 3092 Broadway, Cleveland, Ohio
Associate, Cleveland Branch

Charles T. Vannorsdall, 4202 Fairview Drive, Toledo, Ohio
Associate, Toledo Branch

Edison C. Sickman, 259 Aberdeen Ave., Dayton, Ohio
Associate, Dayton Branch

John F. Daymude, 1174 West Way, Cincinnati, Ohio
Active, Cincinnati Branch

Ferdinand Bode, 551 Armory Ave., Cincinnati, Ohio
Active, Cincinnati Branch

Alcide C. Foreman, 621 Bauerichter St., Cincinnati, Ohio
Active, Cincinnati Branch

George C. Hillenbrand, Batesville Casket Co., Batesville, Ind.
Associate, Cincinnati Branch

John Reeves, 17 Henry St., Batesville, Ind. Associate, Cincinnati Branch

Edward F. Ratterman, 1011 Purcell Ave., Cincinnati, Ohio
Active, Cincinnati Branch

Samuel S. Johnston, Chemical Dept., Weirton Steel Co., Weirton, W. Va.
Associate, Philadelphia Branch

Mathias Foggarty, 48 Court Way, Gipsy Corner, Acton, London W-3, England
Active, Philadelphia Branch

Joe Spallino, 573 Bradshawe Ave., Los Angeles, Cal.
Associate, Los Angeles Branch

Barney A. Lebb, 2700 San Marino St., Los Angeles, Calif.
Active, Los Angeles Branch

RESIGNATIONS

R. G. Grostick, 510 Third St., Detroit, Mich. Associate, Detroit Branch

L. E. Koehle, 127 Huron St., Elyria, Ohio Cleveland Branch

A. E. S. OFFICERS

President: R. M. GOODSELL, 725 Lothrop Ave., Racine, Wis.
First Vice-President: FREDERICK FULFORTH 4 Highland Park, Roslyn, Penna.
Second Vice-President: JOSEPH L. DOWNES 174 Lincoln St., Middletown, Conn.
Third Vice-President: NELSON SIEVERING 24 Stanford Place, Montclair, N. J.
Executive Secretary: W. J. R. KENNEDY 93 Oak Grove Ave., Springfield, Mass.
Past President: W. M. PHILLIPS,
General Motors Corp., R. 11-100, Research Bldg., Detroit, Mich.

BRANCH DIRECTORY

ANDERSON

Meets second Tuesday of every month at 7:30 p.m., at the Anderson, Indiana, Y.M.C.A. Secretary Otto W. McAllister, 622 W 22nd St., Anderson, Ind.

BALTIMORE-WASHINGTON

Meets at Bureau of Standards, Washington, D. C., the first Saturday of each month. Secretary, Irvin H. Hahn, 207 S. Sharp St., Baltimore, Maryland.

BINGHAMTON-SYRACUSE

Meets last Friday of each month at the Cortland Hotel, Cortland, N. Y. Secretary, George Simmons, 309 Park Ave., Herkimer, N. Y.

BOSTON

Meets at Hotel Bradford, Boston, Mass., first Thursday each month. Secretary, A. W. Garrett, 100 King St., Dorchester, Mass.

BRIDGEPORT

Meets first Thursday of each month at Chamber of Commerce Rooms, Stratfield Hotel. Secretary-Treasurer, Eugene Phillips, Roanoke Ave., Fairfield, Conn.

BUFFALO

Meets third Friday of each month at Stratford Arms Hotel. Secretary-Treasurer, Wm. Hart, 237 Laird Ave., Buffalo, N. Y.

CHICAGO

Meets second Saturday of each month, at 8 p.m., Atlantic Hotel, 316 S. Clark St., Secretary M. H. Longfield, 1158 S. Mason Ave., Chicago, Illinois.

CINCINNATI

Meets on fourth Thursday of each month at 8 p.m., at Metropole Hotel. Secretary, Martin M. Gannon, Jr., 4022 Delmar Ave., Cheviot, Ohio

CLEVELAND

Meets first Saturday of each month at Cleveland Hotel. Secretary, P. R. Lyons, 20987 Morewood Parkway, Lakewood, Ohio.

DAYTON

Meets first Friday of each month at the Engineers Club, Dayton, Ohio. Secretary, Corliss Powell, 317 Brooklyn Ave., Dayton, Ohio.

DETROIT

Meets the first Friday of each month at the Hotel Statler. Secretary Wright Wilson, 6623 Appoline, Dearborn, Mich.

GRAND RAPIDS

Meets second Thursday of each month, 7:30 p.m., at The Hotel Rowe, Spanish Room. Secretary, Chas. S. Whalley, 931 Pine Ave., N. W., Grand Rapids, Mich.

HARTFORD

Meets third Monday of each month alternately at State Trade School, 110 Washington St., Hartford and at the Elks Club, corner South and Main Sts., Bristol, Conn. Secretary, Vernon E. Grant, 18 Birge Road, Bristol, Conn.

LOS ANGELES

Meets second Wednesday of each month at 6:30 p.m., at the Rosslyn Hotel, 2nd floor, N. W. Cor. of 5th and Main Sts. Secretary, Raymond Solivan, 4073 Globe, Culver City, Cal.

MILWAUKEE

Meets first Thursday of each month at Republican Hotel. Secretary, Robert B. Goodsell, 5590 Arrow-Wood St., Greendale, Wis.

MONTREAL

Meets first Thursday of each month at New Carlton Hotel, Montreal, Quebec, Canada. Secretary, Arthur W. Jerome, 4806 Cartier St., Montreal, Quebec.

NEWARK

Meets first and third Friday of each month, at Club Room at Hotel Douglas, Newark, N. J., at 8 p.m. Secretary, George Wagner, 1134 So. Long Ave., Hillside, N. J.

NEW HAVEN

Meets first and third Tuesdays of each month at Sterling Chemistry Laboratory, Yale University. Secretary, R. S. Gray, Park Circle Apts., Park Circle, Milford, Conn.

NEW YORK

Meets second and fourth Fridays of each month, in the Hotel Pennsylvania, 7th Ave., and 33rd St., New York City, N. Y. Secretary-Treasurer, Franklyn MacStoker, 25 Princeton St., Garden City, L.I., N.Y.

PHILADELPHIA

Meets fourth Friday of each month, in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary-Treasurer, R. E. Jackson, Jr., 125 E. Allen St., Philadelphia, Pa.

PITTSBURGH

Meets first Friday of each month, at 8 p.m. at U. S. Bureau of Mines, 4800 Forbes Street, Pittsburgh. Secretary, Frank Keller, 815 Ferre St., Coraopolis, Pa.

PROVIDENCE-ATTLEBORO

Meets at the Narragansett Hotel the third Monday of each month. Donald Wood, c/o Reed & Barton, Taunton, Mass.

ROCHESTER

Meets third Friday of each month at the Hotel Seneca. Secretary-Treasurer, Judson R. Elster, 176½ Fulton Ave., Rochester, New York.

SAN FRANCISCO

Meets at Plaza Hotel, San Francisco. Secretary L. W. Miller, 780 22nd St., Oakland, Calif.

SPRINGFIELD

Meets the fourth Monday of each month at the Hotel Charles. Sec.-Treas. D. S. Hartshorn, Jr., 76 Edendale Street, Springfield, Mass.

ST. LOUIS

Meets first Friday of each month, at Central Y.M.C.A., 16th and Locust Sts. Secretary, C. T. McGinley, 8331 Washington St., St. Louis County, Mo.

TOLEDO

Meets first Thursday of each month, in the office of Spanoli Plating Co., 3120 Monroe St. Secretary, Gaston Bergeman, 718 Howland St., Fremont, Ohio.

TORONTO

Meets fourth Monday of each month, at King Edward Hotel, King St., Room G. Secretary-Treasurer, H. Hands, 146 Gowan Ave., Toronto, Ontario, Canada.

WATERBURY

Meets second Friday of the month at Elton Hotel. Secretary, George Muscio, 480 Watertown, Ave., Waterbury, Conn.

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